SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS
MAGLEV DEPLOYMENT PROGRAM

PART 1 - MILESTONE 4
PART 2 - MILESTONE 3
PART 3 - MILESTONE 3

REFINED COST ESTIMATES

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MAGLEV
TURNING THE VISION INTO REALITY

Table of Contents

2.0 Executive Summary

This document presents the three Refined Cost Estimates reports completed as part of the Maglev Deployment Program: Phase 2 Refined Cost Estimates effort. These reports address each of the three project parts, from West Los Angeles to Ontario International Airport, approximately 54 miles in length. The project parts are as follows:

- Part I: Ontario International Airport (ONT) to San Gabriel Valley (19 to 21 miles depending on alignment), with two stations: one in Ontario Airport and the other in West Covina or the City of Industry. There are three different alignments being studied within Part 1.
- Part II: San Gabriel Valley to Union Station (18 to 20 miles depending on alignment), with a station in Los Angels Union Station. There are three different alignments being studied within Part 2.
- Part III: Union Station to West Los Angeles (17 miles), with a station in West Los Angeles. There is one alignment being studied within Part 3.

The subsequent three reports are identified as deliverables under the following project Milestones:

- Part I: Ontario International Airport to San Gabriel Valley – Milestone 4
- Part II: San Gabriel Valley to Union Station – Milestone 3
- Part III: Union Station to West Los Angeles – Milestone 3

Each report discusses the methods and assumptions that are used in developing capital cost estimates. The key elements considered in the cost estimates include:

- Structures/Foundations/Tunnels
- Earthwork
- Stations
- Parking Facilities
- Operation and Maintenance Facilities
- Guideway/ Propulsion/Power Supply/Operation Control (OCS)
- Sound Walls (Noise Protection)
- Safety Fencing/Landscape
- Maglev Vehicles
- ROW/Roadway Improvements/Utility Relocation/Traffic Control
- Contingencies, Project Implementation, and Environmental Mitigation

Alignment Cost Estimates

Overall cost estimates for each of the three alternative maglev alignments are presented here. Additional detail on the cost components for each alignment and each Part under the FRA funding grants are discussed in greater detail later in this report. The three alternative maglev alignments and the estimated cost of each alignment is summarized below:

- I-10 Alignment - $7.811 billion
- Union Pacific Railroad Alignment - $8.066 billion
- SR-60 Alignment- $8.316 billion

Maglev Phase 2 - I-10
Ontario International Airport to West LA Alignment (54.44 miles)
Double Track (4 Stations)
Capital Cost Estimate

Item	Quantity	Unit	Unit Cost	Cost	Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Conversion from feet to meters	0.3048									
Conversion from miles to kilometers	1.6093									
Conversion from cubic yards (cu-yd) to cubic meters (cu-m)	0.7646									
Conversion from square feet (sq-ft) to square meters (sq-m)	0.0929									
Length of Alignment (miles)	54.44									
						10.0%	30.0%	3.0%	43.0%	
Guideway					$ 1,085,492,300	$ 108,549,230	$ 325,647,690	$ 32,564,769	$ 466,761,689	$ 1,552,254,000
Type 1 Guideway	534,100	LF	$ 1,943	$ 1,037,756,300						
Type 3 Guideway	40,800	LF	$ 1,170	$ 47,736,000						
						25.0%	30.0%	3.0%	58.0%	
Structures/Foundations/Tunnels					$ 1,364,124,200	$ 341,031,050	$ 409,237,260	$ 40,923,726	$ 791,192,036	$ 2,155,316,200
Substructure for Guideway Type 1 and 3	287,450	LF	$ 4,516	$ 1,298,124,200						
Elevated Walkways	20,000	LF	$ 800	$ 16,000,000						
Sound Walls	10,000	LF	$ 1,000	$ 10,000,000						
Tunnel substructure	-	LF	$ 15,000	$ -						
Retaining Walls	1	LS	$ 10,000,000	$ 10,000,000						
Ground Densification	1	each	$ 30,000,000	$ 30,000,000						
						25.0%	30.0%	3.0%	58.0%	
Stations/Maintenance Total Cost					$ 803,917,376	$ 200,979,344	$ 241,175,213	$ 24,117,521	$ 466,272,078	$ 1,270,189,500
Stations					$ 594,383,376					
Ontario Airport Station (Center Side Platform Mezzanine)	1	LS	$ 80,377,000	$ 80,377,000						
Ontario Airport Station Parking Structure	5927	Spaces	$ 19,173	$ 113,638,371						
West Covina Station (Center Platform)	1	LS	$ 44,184,000	$ 44,184,000						
West Covina Station Parking Structure	6368	Spaces	$ 19,173	$ 122,093,664						
Union Station (Center Side Platform Mezzanine)	1	LS	$ 80,377,000	$ 80,377,000						
Union Station Parking Structure	3500	Spaces	$ 19,173	$ 67,105,500						
West LA (Center Platform)	1	LS	$ 42,184,000	$ 42,184,000						
West LA Parking Structure	2317	Spaces	$ 19,173	$ 44,423,841						
Maintenance & Operations Facilities					$ 209,534,000					
Central Maintenance Facility & OCC (Building and Non-Maglev Equipment)	1	LS	$ 91,452,000	$ 91,452,000						
Decentral Maintenance Facility (Building and Non-Maglev Equipment)	1	LS	$ 27,332,000	$ 27,332,000						
Maglev Vehicle Equipment	1	LS	$ 70,000,000	$ 70,000,000						
Maglev Maintenance and Inspection Vehicles	1	LS	$ 10,000,000	$ 10,000,000						
Maglev Train Wash Facility	1	LS	$ 7,000,000	$ 7,000,000						
Parking Facility	250	LS	$ 15,000	$ 3,750,000						
						25.0%	30.0%	3.0%	58.0%	
Communications/Signal/Power					$ 849,264,000	$ 212,316,000	$ 254,779,200	$ 25,477,920	$ 492,573,120	$ 1,341,837,100
Power Substations/Distribution	54.44	Mile	$ 10,400,000	$ 566,176,000						
Operations/Control/Communications	54.44	Mile	$ 5,200,000	$ 283,088,000						
						10.0%	5.0%	0.0%	15.0%	
Vehicles Total Cost					$ 800,800,000	$ 80,080,000	$ 40,040,000	$ -	$ 120,120,000	$ 920,920,000
(8) Car Consists	10	each	$ 80,080,000	$ 800,800,000						
						0.0%	0.0%	0.0%	0.0%	
Right of Way					$ 324,049,875	$ -	$ -	$ -	$ -	$ 324,049,900
Right of Way	1	LS	$ 324,049,875	$ 324,049,875						
						25.0%	30.0%	3.0%	58.0%	
Roadway Improvements/Utility Relocation/Traffic Control					$ 156,240,400	$ 39,060,100	$ 46,872,120	$ 4,687,212	$ 90,619,432	$ 246,859,800
Roadway Improvements										
Roadway Improvements w/Drainage	1	LS	$ 45,000,000	$ 45,000,000						
Utility Relocation	1	LS	$ 50,000,000	$ 50,000,000						
Traffic Control During Construction (2.5% of structure+guideway)	1	LS	$ 61,240,400	$ 61,240,400						
					System Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Subtotal					$ 5,383,888,151	$ 982,015,724	$ 1,317,751,483	$ 127,771,148	$ 2,427,538,355	$ 7,811,426,500
Cost per Mile (Double Track System)					$ 98,895,815	$ 18,038,496	$ 24,205,575	$ 2,347,009	$ 44,591,079	$ 143,486,894

Note: All costs are in year 2006$.

Maglev Phase 2 - UPRR Alignment
Ontario International Airport to West LA Alignment (56.33 miles)
Double Track (4 Stations)
Capital Cost Estimate

Item	Quantity	Unit	Unit Cost	Cost	Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Conversion from feet to meters	0.3048									
Conversion from miles to kilometers	1.6093									
Conversion from cubic yards (cu-yd) to cubic meters (cu-m)	0.7646									
Conversion from square feet (sq-ft) to square meters (sq-m)	0.0929									
Length of Alignment (miles)	56.33									
						10.0%	30.0%	3.0%	43.0%	
Guideway					$ 1,133,878,580	$ 113,387,858	$ 340,163,574	$ 34,016,357	$ 487,567,789	$ 1,621,446,400
Type 1 Guideway	566,560	LF	$ 1,943	$ 1,100,826,080						
Type 3 Guideway	28,250	LF	$ 1,170	$ 33,052,500						
						25.0%	30.0%	3.0%	58.0%	
Structures/Foundations/Tunnels					$ 1,454,987,650	$ 363,746,913	$ 436,496,295	$ 43,649,630	$ 843,892,837	$ 2,298,880,500
Substructure for Guideway Type 1 and 3	297,410	LF	$ 4,665	$ 1,387,417,650						
Elevated Walkways	20,900	LF	$ 800	$ 16,720,000						
Sound Walls	10,400	LF	$ 1,000	$ 10,400,000						
Tunnel substructure	-	LF	$ 15,000	$ -						
Retaining Walls	1	LS	$ 10,450,000	$ 10,450,000						
Ground Densification	1	each	$ 30,000,000	$ 30,000,000						
						25.0%	30.0%	3.0%	58.0%	
Stations/Maintenance Total Cost					$ 801,917,376	$ 200,479,344	$ 240,575,213	$ 24,057,521	$ 465,112,078	$ 1,267,029,500
Stations					$ 592,383,376					
Ontario Airport Station (Center Side Platform Mezzanine)	1	LS	$ 80,377,000	$ 80,377,000						
Ontario Airport Station Parking Structure	5927	Spaces	$ 19,173	$ 113,638,371						
Industry Station (Center Platform)	1	LS	$ 42,184,000	$ 42,184,000						
Industry Station Parking Structure	6368	Spaces	$ 19,173	$ 122,093,664						
Union Station (Center Side Platform Mezzanine)	1	LS	$ 80,377,000	$ 80,377,000						
Union Station Parking Structure	3500	Spaces	$ 19,173	$ 67,105,500						
West LA (Center Platform)	1	LS	$ 42,184,000	$ 42,184,000						
West LA Parking Structure	2317	Spaces	$ 19,173	$ 44,423,841						
Maintenance & Operations Facilities					$ 209,534,000					
Central Maintenance Facility & OCC (Building and Non-Maglev Equipment)	1	LS	$ 91,452,000	$ 91,452,000						
Decentral Maintenance Facility (Building and Non-Maglev Equipment)	1	LS	$ 27,332,000	$ 27,332,000						
Maglev Vehicle Equipment	1	LS	$ 70,000,000	$ 70,000,000						
Maglev Maintenance and Inspection Vehicles	1	LS	$ 10,000,000	$ 10,000,000						
Maglev Train Wash Facility	1	LS	$ 7,000,000	$ 7,000,000						
Parking Facility	250	LS	$ 15,000	$ 3,750,000						
						25.0%	30.0%	3.0%	58.0%	
Communications/Signal/Power					$ 878,696,591	$ 219,674,148	$ 263,608,977	$ 26,360,898	$ 509,644,023	$ 1,388,340,600
Power Substations/Distribution	56.33	Mile	$ 10,400,000	$ 585,797,727						
Operations/Control/Communications	56.33	Mile	$ 5,200,000	$ 292,898,864						
						10.0%	5.0%	0.0%	15.0%	
Vehicles Total Cost					$ 800,800,000	$ 80,080,000	$ 40,040,000	$ -	$ 120,120,000	$ 920,920,000
(8) Car Consists	10	each	$ 80,080,000	$ 800,800,000						
						0.0%	0.0%	0.0%	0.0%	
Right of Way					$ 314,461,250	$ -	$ -	$ -	$ -	$ 314,461,300
Right of Way	1	LS	$ 314,461,250	$ 314,461,250						
						25.0%	30.0%	3.0%	58.0%	
Roadway Improvements/Utility Relocation/Traffic Control					$ 161,721,700	$ 40,430,425	$ 48,516,510	$ 4,851,651	$ 93,798,586	$ 255,520,300
Roadway Improvements										
Roadway Improvements w/Drainage	1	LS	$ 47,000,000	$ 47,000,000						
Utility Relocation	1	LS	$ 50,000,000	$ 50,000,000						
Traffic Control During Construction (2.5% of structure+guideway)	1	LS	$ 64,721,700	$ 64,721,700						
					System Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Subtotal					$ 5,546,463,147	$ 1,017,798,687	$ 1,369,400,569	$ 132,936,057	$ 2,520,135,313	$ 8,066,598,600
Cost per Mile (Double Track System)					$ 98,469,513	$ 18,069,559	$ 24,311,747	$ 2,360,089	$ 44,741,395	$ 143,210,910

Note: All costs are in year 2006$.

Maglev Phase 2 - SR-60
Ontario International Airport to West LA Alignment (55.84 miles)
Double Track (4 Stations)
Capital Cost Estimate

Item	Quantity	Unit	Unit Cost	Cost	Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Conversion from feet to meters	0.3048									
Conversion from miles to kilometers	1.6093									
Conversion from cubic yards (cu-yd) to cubic meters (cu-m)	0.7646									
Conversion from square feet (sq-ft) to square meters (sq-m)	0.0929									
Length of Alignment (miles)	58.37									
						10.0%	30.0%	3.0%	43.0%	
Guideway					$ 1,166,126,800	$ 116,612,680	$ 349,838,040	$ 34,983,804	$ 501,434,524	$ 1,667,561,300
Type 1 Guideway	575,600	LF	$ 1,943	$ 1,118,390,800						
Type 3 Guideway	40,800	LF	$ 1,170	$ 47,736,000						
						25.0%	30.0%	3.0%	58.0%	
Structures/Foundations/Tunnels					$ 1,545,797,684	$ 386,449,421	$ 463,739,305	$ 46,373,931	$ 896,562,657	$ 2,442,360,300
Substructure for Guideway Type 1 and 3	288,970	LF	$ 4,813	$ 1,390,679,684						
Elevated Walkways	20,760	LF	$ 800	$ 16,608,000						
Sound Walls	10,310	LF	$ 1,000	$ 10,310,000						
Tunnel substructure	5,880	LF	$ 15,000	$ 88,200,000						
Retaining Walls	1	LS	$ 10,000,000	$ 10,000,000						
Ground Densification	1	each	$ 30,000,000	$ 30,000,000						
						25.0%	30.0%	3.0%	58.0%	
Stations/Maintenance Total Cost					$ 791,187,744	$ 197,796,936	$ 237,356,323	$ 23,735,632	$ 458,888,892	$ 1,250,076,600
Stations					$ 581,653,744					
Ontario Airport Station (Center Side Platform Mezzanine)	1	LS	$ 80,377,000	$ 80,377,000						
Ontario Airport Station Parking Structure	5927	Spaces	$ 19,173	$ 113,638,371						
Puente Hills Station (Center Platform)	1	LS	$ 44,184,000	$ 44,184,000						
Puente Hills Station Parking Structure	6368	Spaces	$ 17,174	$ 109,364,032						
Union Station (Center Side Platform Mezzanine)	1	LS	$ 80,377,000	$ 80,377,000						
Union Station Parking Structure	3500	Spaces	$ 19,173	$ 67,105,500						
West LA (Center Platform)	1	LS	$ 42,184,000	$ 42,184,000						
West LA Parking Structure	2317	Spaces	$ 19,173	$ 44,423,841						
Maintenance & Operations Facilities					$ 209,534,000					
Central Maintenance Facility & OCC (Building and Non-Maglev Equipment)	1	LS	$ 91,452,000	$ 91,452,000						
Decentral Maintenance Facility (Building and Non-Maglev Equipment)	1	LS	$ 27,332,000	$ 27,332,000						
Maglev Vehicle Equipment	1	LS	$ 70,000,000	$ 70,000,000						
Maglev Maintenance and Inspection Vehicles	1	LS	$ 10,000,000	$ 10,000,000						
Maglev Train Wash Facility	1	LS	$ 7,000,000	$ 7,000,000						
Parking Facility	250	LS	$ 15,000	$ 3,750,000						
						25.0%	30.0%	3.0%	58.0%	
Communications/Signal/Power					$ 910,572,000	$ 227,643,000	$ 273,171,600	$ 27,317,160	$ 528,131,760	$ 1,438,703,800
Power Substations/Distribution	58.37	Mile	$ 10,400,000	$ 607,048,000						
Operations/Control/Communications	58.37	Mile	$ 5,200,000	$ 303,524,000						
						10.0%	5.0%	0.0%	15.0%	
Vehicles Total Cost					$ 800,800,000	$ 80,080,000	$ 40,040,000	$ -	$ 120,120,000	$ 920,920,000
(8) Car Consists	10	each	$ 80,080,000	$ 800,800,000						
						0.0%	0.0%	0.0%	0.0%	
Right of Way					$ 339,076,125	$ -	$ -	$ -	$ -	$ 339,076,100
Right of Way	1	LS	$ 339,076,125	$ 339,076,125						
						25.0%	30.0%	3.0%	58.0%	
Roadway Improvements/Utility Relocation/Traffic Control					$ 162,798,100	$ 40,699,525	$ 48,839,430	$ 4,883,943	$ 94,422,898	$ 257,221,000
Roadway Improvements										
Roadway Improvements w/Drainage	1	LS	$ 45,000,000	$ 45,000,000						
Utility Relocation	1	LS	$ 50,000,000	$ 50,000,000						
Traffic Control During Construction (2.5% of structure+guideway)	1	LS	$ 67,798,100	$ 67,798,100						
					System Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Subtotal					$ 5,716,358,453	$ 1,049,281,562	$ 1,412,984,698	$ 137,294,470	$ 2,599,560,730	$ 8,315,919,100
Cost per Mile (Double Track System)					$ 97,933,158	$ 17,976,384	$ 24,207,379	$ 2,352,141	$ 44,535,904	$ 142,469,061

Note: All costs are in year 2006$.

2.4.1 Refined Cost Estimates – Part 1

Overview

This Milestone Report, Refined Cost Estimates for the Maglev Deployment Program: Phase 2 Part I, addresses the methodology for completing a refined cost estimate for the first part of the three segments of the IOS. This report addresses Part I, Ontario International Airport (ONT) to the middle of San Gabriel Valley. Part I is approximately 19 to 21 miles in length depending on the alignment and contains 2 stations (depending on the alignment option, a station could be located in West Covina or the City of Industry). The remaining parts are as follows:

- Part II: San Gabriel Valley to Union Station
- Part III: Union Station to West Los Angeles

Cost estimates are developed based on the following steps:

- Plans and profiles were developed for each alignment alternative. Areas with grades over 3.5% were evaluated in more detail to determine whether special structures, cut sections, or possibly tunnels should be implemented (instead of standard guideway).
- Quantities from the plans and profiles were prepared as an input to capital cost estimating.
- Travel times were re-estimated during Phase 1 of the program. The demand modeling results from Phase 1 helped to determine the size of the vehicle fleet and stations, and were fed into calculation of operating characteristics for the operating and maintenance cost estimates.

The following sections discuss the methods and assumptions that are used in developing capital cost estimates, including associated contingency, project implementation, and environmental impacts. In general, each Maglev technology subsystem includes the design, manufacture, factory commissioning, transport to the site, installation, and commissioning of the subsystem itself. The planning, engineering, project management, overall commissioning, training, and testing required to develop the entire system are defined as program implementation costs. The following sections contain an overview of the elements included in the cost estimates of the various subsystems. Summary sheets containing refined cost estimates for each of the alternatives analyzed are provided at the end of this discussion.

Guideway

The maglev guideway beams are similar to the standardized components for railroads which are mass-produced in a factory under controlled environmental, process, and quality conditions. Each guideway beam type uses a standard design which has been tested and certified to ensure that it achieves all of the Transrapid requirements. The beam type defines the cross section, general length, and application area of the guideway (elevated, at-grade, etc.). A project-specific version of these beams is completed during the engineering process to account for the local design, construction, and environmental situation (temperature, materials, practices, earthquake, etc.). Prior

to production, the project-specific versions are again certified to ensure they meet the Transrapid and local project requirements.

Included in the unit costs are the design, production (including production facility), transport, and installation costs foreseen for each type of guideway beam. The guideway infrastructure consists of the following major elements: guideway beams, guideway switches, and guideway equipment. The guideway costs are estimated for a double-track guideway, based on the Transrapid concrete guideway (from Max Boegl) superstructures (Type I and II beams).

Structures/Foundations/Tunnels

The guideway structures consist of foundations/caissons, support columns, special civil structures (bridges, viaducts), and tunnels. The guideway structure costs are estimated for a double-track guideway. The structure cost per route mile for double track depends on column height and construction complexity. Seven generic categories were used to account for this:

- Structure Type 1 (double track, elevated, single column, with standard Type I guideway)
- Structure Type 2 (double track, elevated, single column, off-set cap, with standard Type I guideway)
- Structure Type 3 (double track, elevated, bent, with standard Type I guideway)
- Structure Type 4 (bridge structure, elevated, single column, with standard Type III guideway)
- Structure Type 5 (bridge structure, elevated, bent, with standard Type III guideway)
- Structure Type 6 (retained cut sections, at-grade, with standard Type III guideway)
- Tunnel Type 7 (double track, single bore, with standard Type III guideway)
- Elevated Walkways

Tunnel structure work includes boring/drilling/digging costs, ventilation systems, and tunnel electrical systems (lighting, fans, et cetera).

The unit costs per foot of guideway structure included within the cost summary sheet for each structure type represents a “rolled up” number that was calculated by dividing the total structure cost for each alignment the associated alignment length. The total structure cost for each structure type actually represents a sum of the independent costs associated with the various component concrete and steel quantities that make up the guideway superstructure (structure types 4 and 5 only), substructure, and foundations along the length of the alignment. Concrete and steel quantities for the various structure types were developed according to the typical sections, alignment geometrics, and structure type limits for each alignment included within the Preliminary Engineering Plans. The alignment was broken down into component segments as identified within the structure data tables in the plans and in order to determine column sizes, structure depths, and foundation dimensions. These values

were determined for each alignment segment separately through structural analysis, and they served as the basis for the calculation of concrete and steel quantities that make up the guideway structures.

Earthwork

Earthwork quantities and associated costs are included in the various items of work including bridges, tunnels, roadway improvements, and stations.

Stations/Parking Facilities/Maintenance Facilities

Stations

Costs for stations are based on drawings prepared by architects, and structural assumptions that have not been confirmed by engineering calculations. It has been assumed that the work will be carried out as a separate contract to the guideway, and will not be impeded by system testing or any other preparation for operations restrictions.

Components of each station include platforms, circulation, lighting, security measures, and auxiliary spaces. Spaces are provided for ticket sales, passenger information, station administration, baggage handling, and commercial space. The station cost estimates include the station building, station interior/equipment with HVAC, platform doors (automatic doors for passenger boarding/debarking and manual doors for emergency use), site development access roads, landscaping and preparation of site, and control and safety equipment.

The station cost estimate has taken into account a station that operates as a land-side facility, which does not require the passengers to have full security screening. Screening arches are included for baggage handling staff, as they will be handling material that will be security screened in the future. No full check-in facilities are included, although it is assumed that remote check-in machines will be available, and thereafter the passenger may drop off hold baggage at a facility at the station. If the station was to operate as an air-side facility, full check-in and security facilities would be provided, with secure air-side to land-side walls, together with staff and security operations rooms.

The size of the station depends on the number of passengers using each station. Each station will have one (center platform) or three (center/side platforms) 680-foot long platforms (appropriate for 8-section maglev vehicles).

Part I of the alignment includes two potential stations:

- Ontario International Airport
- West Covina or City of Industry

In addition, plazas and walkways are also included in the station overall costs. These are based on cost per square foot for plazas, and an average of 12 foot wide per linear foot walkways, with an adjustment rate for width, and vertical access structure to provide access to a 30 foot high walkway, with an adjustment rate for height per foot.

Parking Facilities

Parking requirements were estimated for each of the stations in Phase 1 based on ridership modeling and access mode rates to stations. The design efficiency considered for parking facilities in the maglev stations is approximately 375 sq. ft. per parking space. Components of each parking structure include foundations, structure, vehicle and pedestrian access such as stairs, ramps, elevators, and escalators, mechanical and electrical equipment, and various finishing elements and landscaping.

Costs for parking facilities are based on drawings prepared by architects, and structural assumptions that have not been confirmed by engineering calculations. It has been assumed that the work will be carried out as a separate contract to the stations.

As there are a number of proposed designs for the parking lots for each station, the estimates were based on a per car basis. Two parking lot heights have been used to arrive at an average cost per car; six (which will also be used for the 5 storey parking lot) and eight levels in height. The actual expected cost for each lot will be the product of the per car estimate and the number of vehicles per parking lot.

Part I of the alignment includes parking facilities at the following potential stations:

- Ontario International Airport
- West Covina or City of Industry

Operation and Maintenance Facilities

The operation and maintenance facilities consist of the facilities and equipment required for the operation and maintenance of the Maglev system (operation control center, maintenance facilities, and maintenance vehicles). The major components assumed for Part I are as follows:

- Operations Control Center (OCC)
- Central Maintenance Facility

The Operations Control Center (OCC) is assumed to be part of the central maintenance facility.

The Central Maintenance Facility (assumed to be near Ontario Airport) would house the vehicle maintenance equipment and personnel required for major periodic, scheduled vehicle maintenance and for repair of exterior or interior damage. It will also function as a home base for route maintenance personnel and equipment (guideway, propulsion, etc.). It will include multiple bays for vehicle repair and maintenance work, storage space for spare parts, and areas for offices/administration/personnel. Individual bays will be provided for vehicle integration, major periodic maintenance, and vehicle washing.

The costs were estimated based on drawings prepared by architects, and structural assumptions that have not been confirmed by engineering calculations. It has been assumed that the work will be carried out as a separate contract to the stations.

Propulsion/Power Supply/Operation Control

Propulsion/Power Supply (Double Track)

The propulsion system cost estimates include substations (building and equipment), wayside equipment, and the power supply and distribution equipment for the substations and route. The number of substations and their size is based on the determined operating schedule, train size, route layout (double/single-track), and route performance and characteristics (trip time, travel speed, grades, etc.).

The wayside equipment is the propulsion equipment along the route. These wayside elements include propulsion switch stations, transformers, power rails, and wayside cabling. The wayside cabling includes the propulsion feeder cables, power supply cabling and communication/control cabling (located in the same trench/way). The cabling connects the substations and OCS equipment to the wayside equipment and longstator motor (in the guideway).

The power supply equipment provides power to the substations at the 23 kV level and distributes power to all wayside elements of the system. The power supply equipment includes the following elements: substations, operating facilities, track, and stations. The operating facilities portion provides electrical power to the operation control center (including a non-interruptible supply).

Operation Control (Double Track)

The Operation Control System (OCS) consists of the safety and non-safety related equipment to control and monitor all maglev system equipment as well as provide communication (operation and passenger) and monitoring of the other portions of the route.

The OCS is the safety related portion of the control system and includes: operation control/safety technology, stationary data transmission, radio data transmission, and vehicle on-board and location components (guideway-mounted digital flags) and guideway switch control.

The Infrastructure Control System (ICS) is the non-safety-related portion of the control system and includes: operation communication, passenger communication/information, station support services (ticketing, etc.), station platform doors, emergency communication and surveillance equipment, and facilities monitoring.

OCS and ICS equipment is centrally located in the Operation Control Center and decentrally located in all facilities along the route (substations, wayside equipment, stations, maintenance facilities, and vehicles).

Sound Walls (Noise Protection)

Sound walls along the outside of the guideway are intended to reduce noise from passing trains. An allowance for sound walls will be made for high-speed and sensitive portions (housing developments, etc.) of the alignment.

Safety Fencing/Landscape

Safety fencing is assumed for the at-grade portions of the alignment, and landscaping is assumed along the full length of the alignment.

Vehicles Total Cost

At the first phase of the system, each Maglev train consists of eight (8) cars coupled semi-permanently. The airport connector/suburban carriage body style (Transrapid 09) with wide doors spaced equally along the train, open style seating, baggage racks, and amenities for standing and mobility handicapped passengers is planned for the route. The two types of cars (sections) are end sections and middle sections. The end sections are aerodynamically styled to be the leading (or trailing) end of the train and contain a "driver's compartment" with on-board control systems. One end section in each train will include a baggage compartment for airline luggage and other cargo in uniform aircraft –style containers. Each section includes the following major subassemblies: carriage body, interior furnishings, vehicle on-board operation control system (end sections only), diagnostics, vehicle location system (end sections only), HVAC, and magnetic suspension (undercarriage).

The vehicle fleet and number of sections/vehicles was estimated based on the round-trip time for each alternative, the 10-minute service headway, the train capacity, and the peak passenger segment load for each alternative. Two spares trains were included in the total vehicle fleet size.

ROW/Roadway Improvements/Utility Relocation/Traffic Control

Right of Way

This includes costs associated with the purchase of land or easement rights, including relocation assistance, demolition costs, acquisition services, and the cost of purchase.

Areas where the guideway alignment is located outside of Caltrans, UPRR, or public right of way were included in the cost estimate. Right of way was categorized into areas that shared consistent land uses, typically within the same cities. Additionally, the following assumptions were made:

1) The proposed take area is a 50 foot wide air right, which is considered to be joint, compatible use. Accordingly, the land values were discounted 50%.

2) Land values for commercial, industrial and residential land were established and adjusted down as the project approached its eastern boundary.

3) All public and railroad right of way is valued as "across the fence", which we confirmed with the railroad and the County of Los Angeles Department of Public Works, who is responsible for all Flood Control and some road right of way within LA County.

4) Upward value adjustments were made for all segments where potential full takes were identified.

Roadway Improvements

The proposed Maglev alignment will be located along existing freeways and will cross over numerous local arterials. At several locations it is anticipated that existing roadways will have to be modified to facilitate the installation of the Maglev guideway structure. An allowance for reconstructing or realigning existing roadways and constructing retaining walls in order to conserve right-of-way will be included in the capital cost estimate prepared for this project.

Utility Relocation

Major utility relocations include overhead power lines, and underground facilities such as pipelines, water and sewer mains, and underground duct banks and vaults.

Costs for utility relocation are estimated using the land use categories listed below. More densely built-up areas would be expected to have more utility conflicts with a new transportation system. The following land uses are expected along the alignment:

- Dense Urban Areas;
- Dense Suburban Areas;
- Suburban Areas; and
- Rural Areas.

Traffic Control During Construction

Two basic principles guide the implementation of a highway work zone: public safety and minimum interference to traffic. Although there would be a tremendous effort to minimize the impacts of construction on traffic, a project of this magnitude would require comprehensive traffic control plans (TCPs) for the construction period. All traffic control devices will conform to the latest edition of CALTRANS Traffic Manual of Traffic Control Devices for Construction and Maintenance Work Zones and the Standard Specifications for Public Works Construction.

Cost for preparation and implementation of traffic control plans for this project are estimated at three percent (3%) of actual construction cost of the structures and guideways.

Contingencies, Project Implementation, and Environmental Mitigation

The project implementation costs are typically computed as a percentage of the total construction and procurement costs, excluding vehicle costs, which are applied separately. The implementation costs assumed for the IOS are the following:

Construction Implementation

- 25% Design/Construction Contingency
- 30% Program Implementation

- 3% Environmental Mitigation

Vehicle Implementation

- 10% Cost Contingency
- 5% Procurement and Management

Costs are estimated for complete alternatives and not on a segmented basis. The percentages are based on other completed programs and widely accepted industry standards. The following is a discussion on the components of the implementation costs and the industry standard percentages typically used for estimation.

It should be noted that the implementation costs and contingencies are added as a percentage of certain cost categories based on past experience for projects in the early stages of definition. Contingencies are not to be considered as potential savings. Rather, they are an allowance added to the basic estimate to account for items and conditions that cannot be assessed at the time the estimate is prepared. The contingency amounts are expected to be needed as the project matures.

Design and Construction Contingency (25%)

A design contingency is included in the estimate for each alternative to account for unforeseen items or quantity fluctuations and variances in unit costs. The design contingency reflects the degree of risk associated with the level of engineering data available and design completion achieved for the various design elements. A construction contingency is also included in the estimate to cover the cost of changes in the scope or changed conditions that occur during construction. Typically at a 35% level of engineering and environmental analysis, the combined design and construction contingency is 25 percent and is applied uniformly to all facility and systems costs excluding vehicles.

Program Implementation (30%)

Program Implementation Contingency covers eight project cost items. The following is a detailed discussion for each.

Program and Design Management (5%)

This category reflects the overall management and administration of the project. Included are the program manager's office, contract management and administration, project control including both cost and schedule, general administration, computer support, quality assurance, system safety, publications, public relations, support of the bidding process, agency liaison, community information and involvement, and legal support.

Preliminary Engineering and Environmental Review (3%)

This cost reflects preliminary engineering design to approximately 35% level. This will include geotechnical investigations, land surveying and mapping, engineering architecture, landscape architecture, traffic engineering, right-of-way engineering,

preparation of preliminary plans and analyses in all necessary technical disciplines, and various other technical studies and support of the draft environmental document. The environmental review would entail all studies and analyses necessary to complete both federal and state required environmental documents.

Final Design (7%)

Final design and preparation of construction contingency prepares procurement documents for all facilities and systems. This will include additional geotechnical investigations, land surveying and mapping, engineering, architecture, landscape architecture, traffic engineering, right-of-way engineering, preparation of preliminary plans and analyses in all necessary technical disciplines, and various other technical studies and support of the final design process. Design support during construction, including shop drawing review is also included in this category.

Construction and Procurement Management (5%)

This cost reflects all management of construction and procurement work after contracts are awarded to contractors or suppliers. This will include on-site inspection in both factory and field, quality control, contract administration and acceptance inspection.

Agency Costs (2%)

Agency costs represent the cost of maintaining the owner's organization during the entire program.

Forced Account Costs (1%)

Forced account costs represent the services of other organizations or agencies at the state, local or federal government level that may be required to support the project.

Risk Management (5%)

This contingency reflects the owner supplied insurance or any other allowances decided to be applied for the management of risk to the owner.

Testing and Pre-Revenue Operations (2%)

The costs of the pre-revenue testing, acceptance testing, safety certification and training related to start-up of the system for revenue service.

Environmental Impact Mitigation (3%)

Environmental impact mitigation can include a variety of costs such as traffic impact, noise and visual impact mitigation, wetlands replacement, landscaping, and aesthetic treatments. Based on recent experience with similar capital improvements in Southern California, these costs are assumed to be approximately 3% of the construction costs prior to adding contingencies and other add-on costs.

Guideway Cost Contingency (10%)

At this stage of planning, the guideway unit costs are defined per km or mile for typical elevated or at-grade guideway, regardless of curvature. They are based upon estimates from the current German suppliers of the Transrapid concrete guideway and reflect local material and personnel costs:

- Max Boegl for the guideway beams
- ThyssenKrupp Transrapid for the stator packs and equipment

Included in these unit costs are the design, production (including production facility), transport, and installation costs foreseen for each type of guideway beam. Other than the design modifications due to the local requirements, the guideway beam designs foreseen for the maglev IOS are "standard" and not dependent on their installation location along the route. The quantities are currently defined according to type and route length and not individual beams. The overall size and weight of the beams is also standard and therefore the construction costs per km or mile are relatively independent of changes to the beams foreseen at a given location. Therefore, unless the route length changes significantly, there will be little change in the overall guideway beam cost.

Taken together, these aspects allow a lower contingency to be used for the guideway beams than for other structures and equipment installed along the route (10% for guideway beams vs. 25% for other structures/equipment).

Vehicle Cost Contingency (10%)

This cost contingency is used to account for quantity fluctuations or design variances in vehicle orders. The industry standard for vehicle cost contingency is 10%.

Vehicle Procurement and Management (5%)

The vehicle procurement and management category reflects costs associated with ordering the vehicle fleets and are typically computed as a percentage of the vehicle costs. As with the vehicle cost contingency, the industry standard is 5%.

Maglev Phase 2 - I-10
PART 1: Ontario International Airport to West Covina Alignment (20.19 miles)
Double Track (2 Stations)
Capital Cost Estimate

Item	Quantity	Unit	Unit Cost	Cost	Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Conversion from feet to meters	0.3048									
Conversion from miles to kilometers	1.6093									
Conversion from cubic yards (cu-yd) to cubic meters (cu-m)	0.7646									
Conversion from square feet (sq-ft) to square meters (sq-m)	0.0929									
Length of Alignment (miles)	20.19									
						10.0%	30.0%	3.0%	43.0%	
Guideway					$ 405,358,100	$ 40,535,810	$ 121,607,430	$ 12,160,743	$ 174,303,983	$ 579,662,100
Type 1 Guideway	201,700	LF	$ 1,943	$ 391,903,100						
Type 3 Guideway	11,500	LF	$ 1,170	$ 13,455,000						
						25.0%	30.0%	3.0%	58.0%	
Structures/Foundations/Tunnels					$ 549,959,000	$ 137,489,750	$ 164,987,700	$ 16,498,770	$ 318,976,220	$ 868,935,200
Substructure for Guideway Type 1 and 3	106,600	LF	$ 4,940	$ 526,604,000						
Elevated Walkways	7,420	LF	$ 800	$ 5,936,000						
Sound Walls	3,710	LF	$ 1,000	$ 3,710,000						
Tunnel substructure	-	LF	$ 15,000	$ -						
Retaining Walls	1	LS	3,709,000	$ 3,709,000						
Ground Densification	1	each	$ 10,000,000	$ 10,000,000						
						25.0%	30.0%	3.0%	58.0%	
Stations/Maintenance Total Cost					$ 542,495,035	$ 135,623,759	$ 162,748,511	$ 16,274,851	$ 314,647,120	$ 857,142,200
Stations					$ 360,293,035					
Ontario Airport Station (Center Side Platform Mezzanine)	1	LS	$ 80,377,000	$ 80,377,000						
Ontario Airport Station Parking Structure	5927	Spaces	$ 19,173	$ 113,638,371						
West Covina Station (Center Platform)	1	LS	$ 44,184,000	$ 44,184,000						
West Covina Station Parking Structure	6368	Spaces	$ 19,173	$ 122,093,664						
Maintenance & Operations Facilities					$ 182,202,000					
Central Maintenance Facility & OCC (Building and Non-Maglev Equipment)	1	LS	$ 91,452,000	$ 91,452,000						
Maglev Vehicle Equipment	1	LS	$ 70,000,000	$ 70,000,000						
Maglev Maintenance and Inspection Vehicles	1	LS	$ 10,000,000	$ 10,000,000						
Maglev Train Wash Facility	1	LS	$ 7,000,000	$ 7,000,000						
Parking Facility	250	LS	$ 15,000	$ 3,750,000						
						25.0%	30.0%	3.0%	58.0%	
Communications/Signal/Power					$ 314,954,545	$ 78,738,636	$ 94,486,364	$ 9,448,636	$ 182,673,636	$ 497,628,200
Power Substations/Distribution	20.19	Mile	$ 10,400,000	$ 209,969,697						
Operations/Control/Communications	20.19	Mile	$ 5,200,000	$ 104,984,848						
						10.0%	5.0%	0.0%	15.0%	
Vehicles Total Cost					$ 800,800,000	$ 80,080,000	$ 40,040,000	$ -	$ 120,120,000	$ 920,920,000
(8) Car Consists	10	each	$ 80,080,000	$ 800,800,000						
						0.0%	0.0%	0.0%	0.0%	
Right of Way					$ 65,138,250	$ -	$ -	$ -	$ -	$ 65,138,300
Right of Way	1	LS	$ 65,138,250	$ 65,138,250						
						25.0%	30.0%	3.0%	58.0%	
Roadway Improvements/Utility Relocation/Traffic Control					$ 59,114,200	$ 14,778,550	$ 17,734,260	$ 1,773,426	$ 34,286,236	$ 93,400,400
Roadway Improvements										
Roadway Improvements w/Drainage	1	LS	$ 16,688,500	$ 16,688,500						
Utility Relocation	1	LS	$ 18,542,800	$ 18,542,800						
Traffic Control During Construction (2.5% of structure+guideway)	1	LS	$ 23,882,900	$ 23,882,900						
					System Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Subtotal					$ 2,737,819,130	$ 487,246,505	$ 601,604,264	$ 56,156,426	$ 1,145,007,196	$ 3,882,826,400
Cost per Mile (Double Track System)					$ 135,606,801	$ 24,133,786	$ 29,798,035	$ 2,781,482	$ 56,713,302	$ 192,320,107

Note: All costs are in year 2006$.

Maglev Phase 2 - UPRR Alignment
PART 1: Ontario International Airport to Industry Alignment (21.28 miles)
Double Track (2 Stations)
Capital Cost Estimate

Item	Quantity	Unit	Unit Cost	Cost	Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Conversion from feet to meters	0.3048									
Conversion from miles to kilometers	1.6093									
Conversion from cubic yards (cu-yd) to cubic meters (cu-m)	0.7646									
Conversion from square feet (sq-ft) to square meters (sq-m)	0.0929									
Length of Alignment (miles)	21.28									
						10.0%	30.0%	3.0%	43.0%	
Guideway ==========					$ 432,089,480	$ 43,208,948	$ 129,626,844	$ 12,962,684	$ 185,798,476	$ 617,888,000
Type 1 Guideway	218,860	LF	$ 1,943	$ 425,244,980						
Type 3 Guideway	5,850	LF	$ 1,170	$ 6,844,500						
						25.0%	30.0%	3.0%	58.0%	
Structures/Foundations/Tunnels ==========					$ 585,997,850	$ 146,499,463	$ 175,799,355	$ 17,579,936	$ 339,878,753	$ 925,876,600
Substructure for Guideway Type 1 and 3	112,360	LF	$ 5,000	$ 561,800,000						
Elevated Walkways	7,900	LF	$ 800	$ 6,320,000						
Sound Walls	3,930	LF	$ 1,000	$ 3,930,000						
Tunnel substructure	-	LF	$ 15,000	$ -						
Retaining Walls	1	LS	3,947,850	$ 3,947,850						
Ground Densification	1	each	$ 10,000,000	$ 10,000,000						
	112355									
						25.0%	30.0%	3.0%	58.0%	
Stations/Maintenance Total Cost ==========					$ 540,495,035	$ 135,123,759	$ 162,148,511	$ 16,214,851	$ 313,487,120	$ 853,982,200
Stations					$ 358,293,035					
Ontario Airport Station (Center Side Platform Mezzanine)	1	LS	$ 80,377,000	$ 80,377,000						
Ontario Airport Station Parking Structure	5927	Spaces	$ 19,173	$ 113,638,371						
Industry Station (Center Platform)	1	LS	$ 42,184,000	$ 42,184,000						
Industry Station Parking Structure	6368	Spaces	$ 19,173	$ 122,093,664						
Maintenance & Operations Facilities					$ 182,202,000					
Central Maintenance Facility & OCC (Building and Non-Maglev Equipment)	1	LS	$ 91,452,000	$ 91,452,000						
Maglev Vehicle Equipment	1	LS	$ 70,000,000	$ 70,000,000						
Maglev Maintenance and Inspection Vehicles	1	LS	$ 10,000,000	$ 10,000,000						
Maglev Train Wash Facility	1	LS	$ 7,000,000	$ 7,000,000						
Parking Facility	250	LS	$ 15,000	$ 3,750,000						
						25.0%	30.0%	3.0%	58.0%	
Communications/Signal/Power ==========					$ 331,957,955	$ 82,989,489	$ 99,587,386	$ 9,958,739	$ 192,535,614	$ 524,493,600
Power Substations/Distribution	21.28	Mile	$ 10,400,000	$ 221,305,303						
Operations/Control/Communications	21.28	Mile	$ 5,200,000	$ 110,652,652						
						10.0%	5.0%	0.0%	15.0%	
Vehicles Total Cost ==========					$ 800,800,000	$ 80,080,000	$ 40,040,000	$ -	$ 120,120,000	$ 920,920,000
(8) Car Consists	10	each	$ 80,080,000	$ 800,800,000						
						0.0%	0.0%	0.0%	0.0%	
Right of Way ==========					$ 48,026,750	$ -	$ -	$ -	$ -	$ 48,026,800
Right of Way	1	LS	$ 48,026,750	$ 48,026,750						
						25.0%	30.0%	3.0%	58.0%	
Roadway Improvements/Utility Relocation/Traffic Control==========					$ 62,097,300	$ 15,524,325	$ 18,629,190	$ 1,862,919	$ 36,016,434	$ 98,113,700
Roadway Improvements										
Roadway Improvements w/Drainage	1	LS	$ 17,755,900	$ 17,755,900						
Utility Relocation	1	LS	$ 18,889,200	$ 18,889,200						
Traffic Control During Construction (2.5% of structure+guideway)	1	LS	$ 25,452,200	$ 25,452,200						
					System Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Subtotal ==========					$ 2,801,464,370	$ 503,425,983	$ 625,831,286	$ 58,579,129	$ 1,187,836,397	$ 3,989,300,900
Cost per Mile (Double Track System) ==========					$ 131,651,746	$ 23,657,952	$ 29,410,255	$ 2,752,862	$ 55,821,069	$ 187,472,821

Note: All costs are in year 2006$.

Maglev Phase 2 - SR-60
PART 1: Ontario International Airport to Puente Hills Alignment (18.75 miles)
Double Track (2 Stations)
Capital Cost Estimate

Item	Quantity	Unit	Unit Cost	Cost	Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Conversion from feet to meters	0.3048									
Conversion from miles to kilometers	1.6091									
Conversion from cubic yards (cu-yd) to cubic meters (cu-m)	0.7646									
Conversion from square feet (sq-ft) to square meters (sq-m)	0.0929									
Length of Alignment (miles)	21.28									
						10.0%	30.0%	3.0%	43.0%	
Guideway					$ 426,929,600	$ 42,692,960	$ 128,078,880	$ 12,807,888	$ 183,579,728	$ 610,509,300
Type 1 Guideway	212,200	LF	$ 1,943	$ 412,304,600						
Type 3 Guideway	12,500	LF	$ 1,170	$ 14,625,000						
						25.0%	30.0%	3.0%	58.0%	
Structures/Foundations/Tunnels					$ 622,788,510	$ 155,697,128	$ 186,836,553	$ 18,683,655	$ 361,217,336	$ 984,005,800
Substructure for Guideway Type 1 and 3	96,060	LF	$ 5,780	$ 555,226,800						
Elevated Walkways	7,570	LF	$ 800	$ 6,056,000						
Sound Walls	3,760	LF	$ 1,000	$ 3,760,000						
Tunnel substructure	2,940	LF	$ 15,000	$ 44,100,000						
Retaining Walls	1	LS	3,645,710	$ 3,645,710						
Ground Densification	1	each	$ 10,000,000	$ 10,000,000						
						25.0%	30.0%	3.0%	58.0%	
Stations/Maintenance Total Cost					$ 529,765,403	$ 132,441,351	$ 158,929,621	$ 15,892,962	$ 307,263,934	$ 837,029,300
Stations					$ 347,563,403					
Ontario Airport Station (Center Side Platform Mezzanine)	1	LS	$ 80,377,000	$ 80,377,000						
Ontario Airport Station Parking Structure	5927	Spaces	$ 19,173	$ 113,638,371						
Puente Hills Station (Center Platform)	1	LS	$ 44,184,000	$ 44,184,000						
Puente Hills Station Parking Structure	6368	Spaces	$ 17,174	$ 109,364,032						
Maintenance & Operations Facilities					$ 182,202,000					
Central Maintenance Facility & OCC (Building and Non-Maglev Equipment)	1	LS	$ 91,452,000	$ 91,452,000						
Maglev Vehicle Equipment	1	LS	$ 70,000,000	$ 70,000,000						
Maglev Maintenance and Inspection Vehicles	1	LS	$ 10,000,000	$ 10,000,000						
Maglev Train Wash Facility	1	LS	$ 7,000,000	$ 7,000,000						
Parking Facility	250	LS	$ 15,000	$ 3,750,000						
						25.0%	30.0%	3.0%	58.0%	
Communications/Signal/Power					$ 331,968,000	$ 82,992,000	$ 99,590,400	$ 9,959,040	$ 192,541,440	$ 524,509,400
Power Substations/Distribution	21.28	Mile	$ 10,400,000	$ 221,312,000						
Operations/Control/Communications	21.28	Mile	$ 5,200,000	$ 110,656,000						
						10.0%	5.0%	0.0%	15.0%	
Vehicles Total Cost					$ 800,800,000	$ 80,080,000	$ 40,040,000	$ -	$ 120,120,000	$ 920,920,000
(8) Car Consists	10	each	$ 80,080,000	$ 800,800,000						
						0.0%	0.0%	0.0%	0.0%	
Right of Way					$ 76,985,750	$ -	$ -	$ -	$ -	$ 76,985,800
Right of Way	1	LS	$ 76,985,750	$ 76,985,750						
						25.0%	30.0%	3.0%	58.0%	
Roadway Improvements/Utility Relocation/Traffic Control					$ 60,877,200	$ 15,219,300	$ 18,263,160	$ 1,826,316	$ 35,308,776	$ 96,186,000
Roadway Improvements										
Roadway Improvements w/Drainage	1	LS	$ 16,405,700	$ 16,405,700						
Utility Relocation	1	LS	$ 18,228,500	$ 18,228,500						
Traffic Control During Construction (2.5% of structure+guideway)	1	LS	$ 26,243,000	$ 26,243,000						
					System Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Subtotal					$ 2,850,114,463	$ 509,122,738	$ 631,738,614	$ 59,169,861	$ 1,200,031,214	$ 4,050,145,600
Cost per Mile (Double Track System)					$ 133,933,950	$ 23,924,941	$ 29,686,965	$ 2,780,539	$ 56,392,444	$ 190,326,391

Note: All costs are in year 2006$.

2.3.2 Refined Cost Estimates – Part 2

Overview

This Milestone Report, Refined Cost Estimates for the Maglev Deployment Program: Phase 2 Part II, addresses the methodology for completing a refined cost estimates for the three segments of the IOS. This report will address Part II, from the middle of the San Gabriel Valley to Union Station in downtown Los Angeles. Part II is approximately 18 to 20 miles in length depending on the alignment with one station (at Union Station). The remaining segments are as follows:

- Part I: Ontario International Airport (ONT) to San Gabriel Valley
- Part III: Union Station to West Los Angeles

Cost estimates are developed based on the following steps:

- Plans and profiles were developed for each alignment alternative. Areas with grades over 3.5% were evaluated in more detail to determine whether special structures, cut sections, or possibly tunnels should be implemented (instead of standard guideway).
- Quantities from the plans and profiles were prepared as an input to capital cost estimating.
- Travel times were re-estimated based on current alignment that was developed and refined during Phase 1 of the program. The demand modeling results from Phase 1 helped to determine the size of the vehicle fleet and stations, and were fed into calculation of operating characteristics for the operating and maintenance cost estimates.

The following sections discuss the methods and assumptions that are used in developing capital cost estimates, including associated contingency, project implementation, and environmental impacts. In general, each Maglev technology subsystem includes the design, manufacture, factory commissioning, transport to the site, installation, and commissioning of the subsystem itself. The planning, engineering, project management, overall commissioning, training, and testing required to develop the entire system are defined as program implementation costs. The following sections contain an overview of the elements included in the cost estimates of the various subsystems. Summary sheets containing refined cost estimates for each of the alternatives analyzed are provided at the end of this discussion.

Guideway

The maglev guideway beams are similar to the standardized components for railroads which are mass-produced in a factory under controlled environmental, process, and quality conditions. Each guideway beam type uses a standard design which has been tested and certified to ensure that it achieves all of the Transrapid requirements. The beam type defines the cross section, general length, and application area of the guideway (elevated, at-grade, etc.). A project-specific version of these beams is completed during the engineering process to account for the local design, construction,

and environmental situation (temperature, materials, practices, earthquake, etc.). Prior to production, the project-specific versions are again certified to ensure they meet the Transrapid and local project requirements.

Included in the unit costs are the design, production (including production facility), transport, and installation costs foreseen for each type of guideway beam. The guideway infrastructure consists of the following major elements: guideway beams, guideway switches, and guideway equipment. The guideway costs are estimated for a double-track guideway, based on the Transrapid concrete guideway (from Max Boegl) superstructures (Type I and II beams).

Structures/Foundations/Tunnels

The guideway structures consist of foundations/caissons, support columns, special civil structures (bridges, viaducts), and tunnels. The guideway structure costs are estimated for a double-track guideway. The structure cost per route mile for double track depends on column height and construction complexity. Seven generic categories were used to account for this:

- Structure Type 1 (double track, elevated, single column, with standard Type I guideway)
- Structure Type 2 (double track, elevated, single column, off-set cap, with standard Type I guideway)
- Structure Type 3 (double track, elevated, bent, with standard Type I guideway)
- Structure Type 4 (bridge structure, elevated, single column, with standard Type III guideway)
- Structure Type 5 (bridge structure, elevated, bent, with standard Type III guideway)
- Structure Type 6 (retained cut sections, at-grade, with standard Type III guideway)
- Tunnel Type 7 (double track, single bole, with standard Type III guideway)
- Elevated Walkways

Tunnel structure work includes boring/drilling/digging costs, ventilation systems, and tunnel electrical systems (lighting, fans, et cetera).

The unit costs per foot of guideway structure included within the cost summary sheet for each structure type represents a “rolled up” number that was calculated by dividing the total structure cost for each alignment the associated alignment length. The total structure cost for each structure type actually represents a sum of the independent costs associated with the various component concrete and steel quantities that make up the guideway superstructure (structure types 4 and 5 only), substructure, and foundations along the length of the alignment. Concrete and steel quantities for the various structure types were developed according to the typical sections, alignment geometrics, and structure type limits for each alignment included within the Preliminary Engineering Plans. The alignment was broken down into component segments as identified within the structure data tables in the plans and in order to

determine column sizes, structure depths, and foundation dimensions. These values were determined for each alignment segment separately through structural analysis, and they served as the basis for the calculation of concrete and steel quantities that make up the guideway structures.

Earthwork

Earthwork quantities and associated costs are included in the various items of work including bridges, tunnels, roadway improvements, and stations.

Stations/Parking Facilities/Maintenance Facilities

Stations

Costs for stations are based on drawings prepared by architects, and structural assumptions that have not been confirmed by engineering calculations. It has been assumed that the work will be carried out as a separate contract to the guideway, and will not be impeded by system testing or any other preparation for operations restrictions.

Components of each station include platforms, circulation, lighting, security measures, and auxiliary spaces. Spaces are provided for ticket sales, passenger information, station administration, baggage handling, and commercial space. The station cost estimates include the station building, station interior/equipment with HVAC, platform doors (automatic doors for passenger boarding/debarking and manual doors for emergency use), site development access roads, landscaping and preparation of site, and control and safety equipment.

The station estimate has taken into account a station that operates as a land-side facility, which does not require the passengers to have full security screening. Screening arches are included for baggage handling staff, as they will be handling material that will be security screened in the future. No full check-in facilities are included, although it is assumed that remote check-in machines will be available, and thereafter the passenger may drop off hold baggage at a facility at the station. If the station was to operate as an air-side facility, full check-in and security facilities would be provided, with secure air-side to land-side walls, together with staff and security operations rooms.

The size of the station depends on the number of passengers using each station. Each station will have one (center platform) or three (center/side platforms) 680-foot long platforms (appropriate for 8-section maglev vehicles).

Part II of the alignment includes only one station:

- Los Angeles Union Station

In addition, plazas and walkways are also included in the station overall costs. These are based on cost per square foot for plazas, and an average of 12 foot wide per linear foot walkways, with an adjustment rate for width, and vertical access structure to provide access to a 30 foot high walkway, with an adjustment rate for height per foot.

Parking Facilities

Parking requirements were estimated for each of the stations in Phase II based on ridership modeling and access mode rates to stations. The design efficiency considered for parking facilities in the maglev stations is approximately 375 sq. ft. per parking space. Components of each parking structure include foundations, structure, vehicle and pedestrian access such as stairs, ramps, elevators, and escalators, mechanical and electrical equipment, including collection of parking fees, and various finishing elements and landscaping.

Costs for parking facilities are based on drawings prepared by architects, and structural assumptions that have not been confirmed by engineering calculations. It has been assumed that the work will be carried out as a separate contract to the stations.

As there are a number of proposed designs for the parking lots for each station, the estimates were based on a per car basis. Two parking lot heights have been used to arrive at an average cost per car; six (which will also be used for the 5 storey parking lot) and eight levels in height. The actual expected cost for each lot will be the product of the per car estimate and the number of vehicles per parking lot.

Part II of the alignment includes parking facilities at the following potential station:

- Los Angeles Union Station

Operation and Maintenance Facilities

Although it is anticipated that the Central Maintenance Facility and Operations Control Center will be located in the Ontario Airport area, an alternative location for a maintenance facility along the Part II alignment segments is explored. The operation and maintenance facilities consist of the facilities and equipment required for the operation and maintenance of the Maglev system (operation control center, maintenance facilities, and maintenance vehicles). The major components assumed for Part II are as follows:

- Operations Control Center (OCC)
- Central Maintenance Facility

The Operations Control Center (OCC) is assumed to be part of the central maintenance facility.

The Central Maintenance Facility would house the vehicle maintenance equipment and personnel required for major periodic, scheduled vehicle maintenance and for repair of exterior or interior damage. It will also be a home base for route maintenance personnel and equipment (guideway, propulsion, etc.). It will include multiple bays for vehicle repair and maintenance work, storage space for spare parts, and areas for offices/administration/personnel. Individual bays will be provided for vehicle integration, major periodic maintenance, and vehicle washing.

The costs were estimated based on drawings prepared by architects, and structural assumptions that have not been confirmed by engineering calculations. It has been assumed that the work will be carried out as a separate contract to the stations.

Propulsion/Power Supply/Operation Control

Propulsion/Power Supply (Double Track)

The propulsion system cost estimates include substations (building and equipment), wayside equipment, and the power supply and distribution equipment for the substations and route. The number of substations and their size is based on the determined operating schedule, train size, route layout (double/single-track), and route performance and characteristics (trip time, travel speed, grades, etc.).

The wayside equipment is the propulsion equipment along the route. These wayside elements include propulsion switch stations, transformers, power rails, and wayside cabling. The wayside cabling includes the propulsion feeder cables, power supply cabling and communication/control cabling (located in the same trench/way). The cabling connects the substations and OCS equipment to the wayside equipment and longstator motor (in the guideway).

The power supply equipment provides power to the substations at the 23 kV level and distributes power to all wayside elements of the system. The power supply equipment includes the following elements: substations, operating facilities, track, and stations. The operating facilities portion provides electrical power to the operation control center (including a non-interruptible supply).

Operation Control (Double Track)

The Operation Control System (OCS) consists of the safety and non-safety related equipment to control and monitor all maglev system equipment as well as provide communication (operation and passenger) and monitoring of the other portions of the route.

The OCS is the safety related portion of the control system and includes: operation control/safety technology, stationary data transmission, radio data transmission, and vehicle on-board and location components (guideway-mounted digital flags) and guideway switch control.

The Infrastructure Control System (ICS) is the non-safety-related portion of the control system and includes: operation communication, passenger communication/information, station support services (ticketing, etc.), station platform doors, emergency communication and surveillance equipment, and facilities monitoring.

OCS and ICS equipment is centrally located in the Operation Control Center and decentrally located in all facilities along the route (substations, wayside equipment, stations, maintenance facilities, and vehicles).

Sound Walls (Noise Protection)

Sound walls along the outside of the guideway are intended to reduce noise from passing trains. An allowance for sound walls will be made high-speed and sensitive portions (housing developments, etc.) of the alignment.

Safety Fencing/Landscape

Safety fencing is assumed for the at-grade portions of the alignment, and landscaping is assumed along the full length of the alignment.

Vehicles Total Cost

At the first phase of the system, each Maglev train consists of eight (8) cars coupled semi-permanently. The airport connector/suburban carriage body style (Transrapid 09) with wide doors spaced equally along the train, open style seating, baggage racks, and amenities for standing and mobility handicapped passengers is planned for the route. The two types of cars (sections) are end sections and middle sections. The end sections are aerodynamically styled to be the leading (or trailing) end of the train and contain a "driver's compartment" with on-board control systems. One end section in each train will include a baggage compartment for airline luggage and other cargo in uniform aircraft-style containers. Each section includes the following major subassemblies: carriage body, interior furnishings, vehicle on-board operation control system (end sections only), diagnostics, vehicle location system (end sections only), HVAC, and magnetic suspension (undercarriage).

The vehicle fleet and number of sections/vehicles was estimated based on the round-trip time for each alternative, the 10-minute service headway, the train capacity and the peak passenger segment load for each alternative. Two spares trains were included in the total vehicle fleet size.

ROW/Roadway Improvements/Utility Relocation/Traffic Control

Right of Way

This includes costs associated with the purchase of land or easement rights, including relocation assistance, demolition costs, acquisition services, and the cost of purchase.

Areas where the guideway alignment is located outside of Caltrans, UPRR, or public right of way were included in the cost estimate. Right of way was categorized into areas that shared consistent land uses, typically within the same cities. Additionally, the following assumptions were made:

1) The proposed take area is a 50 foot wide air right, which is considered to be joint, compatible use. Accordingly, the land values were discounted 50%.

2) Land values for commercial, industrial and residential land were established and adjusted down as the project approached its eastern boundary.

3) All public and railroad right of way is valued as "across the fence", which we confirmed with the railroad and the County of Los Angeles Department of Public Works, who is responsible for all Flood Control and some road right of way within LA County.

4) Upward value adjustments were made for all segments where potential full takes were identified.

Roadway Improvements

The proposed Maglev alignment will be located along existing freeways and will cross over numerous local arterials. At several locations it is anticipated that existing roadways will have to be modified to facilitate the installation of the Maglev guideway structure. An allowance for reconstructing or realigning existing roadways and constructing retaining walls in order to conserve right-of-way will be included in the capital cost estimate prepared for this project.

Utility Relocation

Major utility relocations include overhead power lines, and underground facilities such as pipelines, water and sewer mains, and underground duct banks and vaults.

Costs for utility relocation are estimated using the land use categories listed below. More densely built-up areas would be expected to have more utility conflicts with a new transportation system. The following land uses are expected along the alignment:

- Dense Urban Areas;
- Dense Suburban Areas;
- Suburban Areas; and
- Rural Areas

Traffic Control During Construction

Two basic principles guide the implementation of a highway work zone: public safety and minimum interference to traffic. And although there would be a tremendous effort to minimize the impacts of construction on traffic, a project of this magnitude would require comprehensive traffic control plans (TCPs) for the construction period. All traffic control devices will conform to the latest edition of CALTRANS Traffic Manual of Traffic Control Devices for Construction and Maintenance Work Zones and the Standard Specifications for Public Works Construction.

Cost for preparation and implementation of traffic control plans for this project are estimated at three percent (3%) of actual construction cost of the structures and guideways.

Contingencies, Project Implementation, and Environmental Mitigation

The project implementation costs are typically computed as a percentage of the total construction and procurement costs, excluding vehicle costs, which are applied separately. The implementation costs assumed for the IOS are the following:

Construction Implementation

- 25% Design/Construction Contingency
- 30% Program Implementation

- 3% Environmental Mitigation

Vehicle Implementation

- 10% Cost Contingency
- 5% Procurement and Management

Costs are estimated for complete alternatives and not on a segmented basis. The percentages are based on other completed programs and widely accepted industry standards. The following is a discussion on the components of the implementation costs and the industry standard percentages typically used for estimation.

It should be noted that the implementation costs and contingencies are added as a percentage of certain cost categories based on past experience for projects in the early stages of definition. Contingencies are not to be considered as potential savings. Rather, they are an allowance added to the basic estimate to account for items and conditions that cannot be assessed at the time the estimate is prepared. The contingency amounts are expected to be needed as the project matures.

Design and Construction Contingency (25%)

A design contingency is included in the estimate for each alternative to account for unforeseen items or quantity fluctuations and variances in unit costs. The design contingency reflects the degree of risk associated with the level of engineering data available and design completion achieved for the various design elements. A construction contingency is also included in the estimate to cover the cost of changes in the scope or changed conditions that occur during construction. Typically at a 35% level of engineering and environmental analysis, the combined design and construction contingency is 25 percent and is applied uniformly to all facility and systems costs excluding vehicles.

Program Implementation (30%)

Program Implementation Contingency covers eight project cost items. The following is a detailed discussion for each.

Program and Design Management (5%)

This category reflects the overall management and administration of the project. Included are the program manger's office, contract management and administration, project control including both cost and schedule, general administration, computer support, quality assurance, system safety, publications, public relations, support of the bidding process, agency liaison, community information and involvement, and legal support.

Preliminary Engineering and Environmental Review (3%)

This cost reflects preliminary engineering design to approximately 35% level. This will include geotechnical investigations, land surveying and mapping, engineering architecture, landscape architecture, traffic engineering, right-of-way engineering, preparation of preliminary plans and analyses in all necessary technical disciplines, and various other technical studies and support of the draft environmental document.

The environmental review would entail all studies and analyses necessary to complete both federal and state required environmental documents.

Final Design (7%)

Final design and preparation of construction contingency prepares procurement documents for all facilities and systems. This will include additional geotechnical investigations, land surveying and mapping, engineering, architecture, landscape architecture, traffic engineering, right-of-way engineering, preparation of preliminary plans and analyses in all necessary technical disciplines, and various other technical studies and support of the final design process. Design support during construction, including shop drawing review is also included in this item.

Construction and Procurement Management (5%)

This cost reflects all management of construction and procurement work after contracts are awarded to contractors or suppliers. This will include on-site inspection in both factory and field, quality control, contract administration and acceptance inspection.

Agency Costs (2%)

Agency costs represent the cost of maintaining the owner's organization during the entire program.

Forced Account Costs (1%)

Forced account costs represent the services of other organizations or agencies at the state, local or federal government level that may be required to support the project.

Risk Management (5%)

This contingency reflects the owner supplied insurance or any other allowances decided to be applied for the management of risk to the owner.

Testing and Pre-Revenue Operations (2%)

The costs of the pre-revenue testing, acceptance testing, safety certification and training related to start-up of the system for revenue service.

Environmental Impact Mitigation (3%)

Environmental impact mitigation can include a variety of costs such as traffic impact, noise and visual impact mitigation, wetlands replacement, landscaping, and aesthetic treatments. Based on recent experience with similar capital improvements in Southern California, these costs are assumed to be approximately 3% of the construction costs prior to adding contingencies and other add-on costs.

Guideway Cost Contingency (10%)

At this stage of planning, the guideway unit costs are defined per km or mile for typical elevated or at-grade guideway, regardless of curvature. They are based upon

estimates from the current German suppliers of the Transrapid concrete guideway and reflect local material and personnel costs:

- Max Boegl for the guideway beams
- ThyssenKrupp Transrapid for the stator packs and equipment

Included in these unit costs are the design, production (including production facility), transport, and installation costs foreseen for each type of guideway beam. Other than the design modifications due to the local requirements, the guideway beam designs foreseen for the maglev IOS are "standard" and not dependent on their installation location along the route. The quantities are currently defined according to type and route length and not individual beams. The overall size and weight of the beams is also standard and therefore the construction costs per km or mile are relatively independent of changes to the beams foreseen at a given location. Therefore, unless the route length changes significantly, there will be little change in the overall guideway beam cost.

Taken together, these aspects allow a lower contingency to be used for the guideway beams than for other structures and equipment installed along the route (10% for guideway beams vs. 25% for other structures/equipment).

Vehicle Cost Contingency (10%)

This cost contingency is used to account for quantity fluctuations or design variances in vehicle orders. The industry standard for vehicle cost contingency is 10%.

Vehicle Procurement and Management (5%)

The vehicle procurement and management category reflects costs associated with ordering the vehicle fleets and are typically computed as a percentage of the vehicle costs. As with the vehicle cost contingency, the industry standard is 5%.

Maglev Phase 2 - I-10
PART 2: West Covina to Union Station Alignment (17.92 miles)
Double Track (1 Station)
Capital Cost Estimate

Item	Quantity	Unit	Unit Cost	Cost	Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Conversion from feet to meters	0.3048									
Conversion from miles to kilometers	1.6093									
Conversion from cubic yards (cu-yd) to cubic meters (cu-m)	0.7646									
Conversion from square feet (sq-ft) to square meters (sq-m)	0.0929									
Length of Alignment (miles)	17.92									
						10.0%	30.0%	3.0%	43.0%	
Guideway					$ 356,175,200	$ 35,617,520	$ 106,852,560	$ 10,685,256	$ 153,155,336	$ 509,330,500
Type 1 Guideway	174,400	LF	$ 1,943	$ 338,859,200						
Type 3 Guideway	14,800	LF	$ 1,170	$ 17,316,000						
						25.0%	30.0%	3.0%	58.0%	
Structures/Foundations/Tunnels					$ 465,519,000	$ 116,379,750	$ 139,655,700	$ 13,965,570	$ 270,001,020	$ 735,520,000
Substructure for Guideway Type 1 and 3	94,600	LF	$ 4,690	$ 443,674,000						
Elevated Walkways	6,580	LF	$ 800	$ 5,264,000						
Sound Walls	3,290	LF	$ 1,000	$ 3,290,000						
Tunnel substructure	-	LF	$ 15,000	$ -						
Retaining Walls	1	LS	3,291,000	$ 3,291,000						
Ground Densification	1	each	$ 10,000,000	$ 10,000,000						
						25.0%	30.0%	3.0%	58.0%	
Stations/Maintenance Total Cost					$ 147,482,500	$ 36,870,625	$ 44,244,750	$ 4,424,475	$ 85,539,850	$ 233,022,400
Stations					$ 147,482,500					
Union Station (Center Side Platform Mezzanine)	1	LS	$ 80,377,000	$ 80,377,000						
Union Station Parking Structure	3500	Spaces	$ 19,173	$ 67,105,500						
						25.0%	30.0%	3.0%	58.0%	
Communications/Signal/Power					$ 279,500,000	$ 69,875,000	$ 83,850,000	$ 8,385,000	$ 162,110,000	$ 441,610,000
Power Substations/Distribution	17.92	Mile	$ 10,400,000	$ 186,333,333						
Operations/Control/Communications	17.92	Mile	$ 5,200,000	$ 93,166,667						
						0.0%	0.0%	0.0%	0.0%	
Right of Way					$ 113,722,625	$ -	$ -	$ -	$ -	$ 113,722,600
Right of Way	1	LS	$ 113,722,625	$ 113,722,625						
						25.0%	30.0%	3.0%	58.0%	
Roadway Improvements/Utility Relocation/Traffic Control					$ 51,807,700	$ 12,951,925	$ 15,542,310	$ 1,554,231	$ 30,048,466	$ 81,856,200
Roadway Improvements										
Roadway Improvements w/Drainage	1	LS	$ 14,809,900	$ 14,809,900						
Utility Relocation	1	LS	$ 16,455,400	$ 16,455,400						
Traffic Control During Construction (2.5% of structure+guideway)	1	LS	$ 20,542,400	$ 20,542,400						
					System Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Subtotal					$ 1,414,207,025	$ 271,694,820	$ 390,145,320	$ 39,014,532	$ 700,854,672	$ 2,115,061,700
Cost per Mile (Double Track System)					$ 78,932,485	$ 15,164,362	$ 21,775,553	$ 2,177,555	$ 39,117,470	$ 118,049,955

Note: All costs are in year 2006$.

Maglev Phase 2 - UPRR Alignment
PART 2: Industry to Union Station Alignment (18.71 miles)
Double Track (1 Station)
Capital Cost Estimate

Item	Quantity	Unit	Unit Cost	Cost	Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Conversion from feet to meters	0.3048									
Conversion from miles to kilometers	1.6093									
Conversion from cubic yards (cu-yd) to cubic meters (cu-m)	0.7646									
Conversion from square feet (sq-ft) to square meters (sq-m)	0.0929									
Length of Alignment (miles)	18.71									
						10.0%	30.0%	3.0%	43.0%	
Guideway					$ 377,830,100	$ 37,783,010	$ 113,349,030	$ 11,334,903	$ 162,466,943	$ 540,297,000
Type 1 Guideway	189,700	LF	$ 1,943	$ 368,587,100						
Type 3 Guideway	7,900	LF	$ 1,170	$ 9,243,000						
						25.0%	30.0%	3.0%	58.0%	
Structures/Foundations/Tunnels					$ 520,425,560	$ 130,106,390	$ 156,127,668	$ 15,612,767	$ 301,846,825	$ 822,272,400
Substructure for Guideway Type 1 and 3	98,800	LF	$ 5,040	$ 497,952,000						
Elevated Walkways	6,940	LF	$ 800	$ 5,552,000						
Sound Walls	3,450	LF	$ 1,000	$ 3,450,000						
Tunnel substructure	-	LF	$ 15,000	$ -						
Retaining Walls	1	LS	3,471,560	$ 3,471,560						
Ground Densification	1	each	$ 10,000,000	$ 10,000,000						
						25.0%	30.0%	3.0%	58.0%	
Stations/Maintenance Total Cost					$ 147,482,500	$ 36,870,625	$ 44,244,750	$ 4,424,475	$ 85,539,850	$ 233,022,400
Stations					$ 147,482,500					
Union Station (Center Side Platform Mezzanine)	1	LS	$ 80,377,000	$ 80,377,000						
Union Station Parking Structure	3500	Spaces	$ 19,173	$ 67,105,500						
						25.0%	30.0%	3.0%	58.0%	
Communications/Signal/Power					$ 291,909,091	$ 72,977,273	$ 87,572,727	$ 8,757,273	$ 169,307,273	$ 461,216,400
Power Substations/Distribution	18.71	Mile	$ 10,400,000	$ 194,606,061						
Operations/Control/Communications	18.71	Mile	$ 5,200,000	$ 97,303,030						
						0.0%	0.0%	0.0%	0.0%	
Right of Way					$ 121,245,500	$ -	$ -	$ -	$ -	$ 121,245,500
Right of Way	1	LS	$ 121,245,500	$ 121,245,500						
						25.0%	30.0%	3.0%	58.0%	
Roadway Improvements/Utility Relocation/Traffic Control					$ 54,680,400	$ 13,670,100	$ 16,404,120	$ 1,640,412	$ 31,714,632	$ 86,395,000
Roadway Improvements										
Roadway Improvements w/Drainage	1	LS	$ 15,613,700	$ 15,613,700						
Utility Relocation	1	LS	$ 16,610,300	$ 16,610,300						
Traffic Control During Construction (2.5% of structure+guideway)	1	LS	$ 22,456,400	$ 22,456,400						
					System Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Subtotal					$ 1,513,573,151	$ 291,407,398	$ 417,698,295	$ 41,769,830	$ 750,875,523	$ 2,264,448,700
Cost per Mile (Double Track System)					$ 80,887,310	$ 15,573,189	$ 22,322,338	$ 2,232,234	$ 40,127,761	$ 121,015,072

Note: All costs are in year 2006$.

Maglev Phase 2 - SR-60
PART 2: Puente Hills to Union Station Alignment (20.76 miles)
Double Track (1 Station)
Capital Cost Estimate

Item	Quantity	Unit	Unit Cost	Cost	Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Conversion from feet to meters	0.3048									
Conversion from miles to kilometers	1.6091									
Conversion from cubic yards (cu-yd) to cubic meters (cu-m)	0.7646									
Conversion from square feet (sq-ft) to square meters (sq-m)	0.0929									
Length of Alignment (miles)	20.76									
						10.0%	30.0%	3.0%	43.0%	
Guideway					$ 415,238,200	$ 41,523,820	$ 124,571,460	$ 12,457,146	$ 178,552,426	$ 593,790,600
Type 1 Guideway	205,400	LF	$ 1,943	$ 399,092,200						
Type 3 Guideway	13,800	LF	$ 1,170	$ 16,146,000						
						25.0%	30.0%	3.0%	58.0%	
Structures/Foundations/Tunnels					$ 574,932,220	$ 143,733,055	$ 172,479,666	$ 17,247,967	$ 333,460,688	$ 908,392,900
Substructure for Guideway Type 1 and 3	106,660	LF	$ 4,760	$ 507,701,600						
Elevated Walkways	7,380	LF	$ 800	$ 5,904,000						
Sound Walls	3,670	LF	$ 1,000	$ 3,670,000						
Tunnel substructure	2,940	LF	$ 15,000	$ 44,100,000						
Retaining Walls	1	LS	3,556,620	$ 3,556,620						
Ground Densification	1	each	$ 10,000,000	$ 10,000,000						
						25.0%	30.0%	3.0%	58.0%	
Stations/Maintenance Total Cost					$ 147,482,500	$ 36,870,625	$ 44,244,750	$ 4,424,475	$ 85,539,850	$ 233,022,400
Stations					$ 147,482,500					
Union Station (Center Side Platform Mezzanine)	1	LS	$ 80,377,000	$ 80,377,000						
Union Station Parking Structure	3500	Spaces	$ 19,173	$ 67,105,500						
						25.0%	30.0%	3.0%	58.0%	
Communications/Signal/Power					$ 323,818,560	$ 80,954,640	$ 97,145,568	$ 9,714,557	$ 187,814,765	$ 511,633,300
Power Substations/Distribution	20.76	Mile	$ 10,400,000	$ 215,879,040						
Operations/Control/Communications	20.76	Mile	$ 5,200,000	$ 107,939,520						
						0.0%	0.0%	0.0%	0.0%	
Right of Way					$ 116,901,375	$ -	$ -	$ -	$ -	$ 116,901,400
Right of Way	1	LS	$ 116,901,375	$ 116,901,375						
						25.0%	30.0%	3.0%	58.0%	
Roadway Improvements/Utility Relocation/Traffic Control					$ 58,542,200	$ 14,635,550	$ 17,562,660	$ 1,756,266	$ 33,954,476	$ 92,496,700
Roadway Improvements										
Roadway Improvements w/Drainage	1	LS	$ 16,004,800	$ 16,004,800						
Utility Relocation	1	LS	$ 17,783,100	$ 17,783,100						
Traffic Control During Construction (2.5% of structure+guideway)	1	LS	$ 24,754,300	$ 24,754,300						
					System Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Subtotal					$ 1,636,915,055	$ 317,717,690	$ 456,004,104	$ 45,600,410	$ 819,322,204	$ 2,456,237,300
Cost per Mile (Double Track System)					$ 78,849,473	$ 15,304,320	$ 21,965,516	$ 2,196,552	$ 39,466,387	$ 118,315,862

Note: All costs are in year 2006$.

2.3.3 Refined Cost Estimates – Part 3

Overview

This Milestone Report, Refined Cost Estimates for the Maglev Deployment Program: Phase 2 Part III, addresses the methodology for completing a refined cost estimate for the three segments of the IOS. This report addresses Part III: Union Station to West Los Angeles. Part III is approximately 17 miles with one station at West Los Angeles. The remaining segments are as follows:

- Part I: Ontario International Airport (ONT) to San Gabriel Valley
- Part II: San Gabriel Valley to Union Station

Cost estimates are developed based on the following steps:

- Plans and profiles were developed for each alignment alternative. Areas with grades over 3.5% were evaluated in more detail to determine whether special structures, cut sections, or possibly tunnels should be implemented (instead of standard guideway).
- Quantities from the plans and profiles were prepared as an input to capital cost estimating.
- Travel times were re-estimated based on current alignment that was developed and refined during Phase 1 of the program. The demand modeling results from Phase 1 helped to determine the size of the vehicle fleet and stations, and were fed into calculation of operating characteristics for the operating and maintenance cost estimates.

The following sections discuss the methods and assumptions that are used in developing capital cost estimates, including associated contingency, project implementation, and environmental impacts. In general, each Maglev technology subsystem includes the design, manufacture, factory commissioning, transport to the site, installation, and commissioning of the subsystem itself. The planning, engineering, project management, overall commissioning, training, and testing required to develop the entire system are defined as program implementation costs. The following sections contain an overview of the elements included in the cost estimates of the various subsystems. Summary sheets containing refined cost estimates for each of the alternatives analyzed are provided at the end of this discussion.

Guideway

The maglev guideway beams are similar to the standardized components for railroads which are mass-produced in a factory under controlled environmental, process, and quality conditions. Each guideway beam type uses a standard design which has been tested and certified to ensure that it achieves all of the Transrapid requirements. The beam type defines the cross section, general length, and application area of the guideway (elevated, at-grade, etc.). A project-specific version of these beams is completed during the engineering process to account for the local design, construction, and environmental situation (temperature, materials, practices, earthquake, etc.). Prior to production, the project-specific versions are again certified to ensure they meet the Transrapid and local project requirements.

Included in the unit costs are the design, production (including production facility), transport, and installation costs foreseen for each type of guideway beam. The guideway infrastructure consists of the following major elements: guideway beams, guideway switches, and guideway equipment. The guideway costs are estimated for a double-track guideway, based on the Transrapid concrete guideway (from Max Boegl) superstructures (Type I and II beams).

Structures/Foundations/Tunnels

The guideway structures consist of foundations/caissons, support columns, special civil structures (bridges, viaducts), and tunnels. The guideway structure costs are estimated for a double-track guideway. The structure cost per route mile for double track depends on column height and construction complexity. Seven generic categories were used to account for this:

- Structure Type 1 (double track, elevated, single column, with standard Type I guideway)
- Structure Type 2 (double track, elevated, single column, off-set cap, with standard Type I guideway)
- Structure Type 3 (double track, elevated, bent, with standard Type I guideway)
- Structure Type 4 (bridge structure, elevated, single column, with standard Type III guideway)
- Structure Type 5 (bridge structure, elevated, bent, with standard Type III guideway)
- Structure Type 6 (retained cut sections, at-grade, with standard Type III guideway)
- Tunnel Type 7 (double track, single bole, with standard Type III guideway)
- Elevated Walkways

Tunnel structure work includes boring/drilling/digging costs, ventilation systems, and tunnel electrical systems (lighting, fans, et cetera). However, tunneling is not expected in Part III of the alignment.

The unit costs per foot of guideway structure included within the cost summary sheet for each structure type represents a “rolled up” number that was calculated by dividing the total structure cost for each alignment the associated alignment length. The total structure cost for each structure type actually represents a sum of the independent costs associated with the various component concrete and steel quantities that make up the guideway superstructure (structure types 4 and 5 only), substructure, and foundations along the length of the alignment. Concrete and steel quantities for the various structure types were developed according to the typical sections, alignment geometrics, and structure type limits for each alignment included within the Preliminary Engineering Plans. The alignment was broken down into component segments as identified within the structure data tables in the plans and in order to determine column sizes, structure depths, and foundation dimensions. These values were determined for each alignment segment separately through structural analysis,

and they served as the basis for the calculation of concrete and steel quantities that make up the guideway structures.

Earthwork

Earthwork quantities and associated costs are included in the various items of work including bridges, tunnels, roadway improvements, and stations.

Stations/Parking Facilities/Maintenance Facilities

Stations

Costs for stations are based on drawings prepared by architects, and structural assumptions that have not been confirmed by engineering calculations. It has been assumed that the work will be carried out as a separate contract to the guideway, and will not be impeded by system testing or any other preparation for operations restrictions.

Components of each station include platforms, circulation, lighting, security measures, and auxiliary spaces. Spaces are provided for ticket sales, passenger information, station administration, baggage handling, and commercial space. The station cost estimates include the station building, station interior/equipment with HVAC, platform doors (automatic doors for passenger boarding/debarking and manual doors for emergency use), site development access roads, landscaping and preparation of site, and control and safety equipment.

The station estimate has taken into account a station that operates as a land-side facility, which does not require the passengers to have full security screening. Screening arches are included for baggage handling staff, as they will be handling material that will be security screened in the future. No full check-in facilities are included, although it is assumed that remote check-in machines will be available, and thereafter the passenger may drop off hold baggage at a facility at the station. If the station was to operate as an air-side facility, full check-in and security facilities would be provided, with secure air-side to land-side walls, together with staff and security operations rooms.

The size of the station depends on the number of passengers using each station. Each station will have one (center platform) or three (center/side platforms) 680-foot long platforms (appropriate for 8-section maglev vehicles).

Part III of the alignment includes only one station:

- West Los Angeles

In addition, plazas and walkways are also included in the station overall costs. These are based on cost per square foot for plazas, and an average of 12 foot wide per linear foot walkways, with an adjustment rate for width, and vertical access structure to provide access to a 30 foot high walkway, with an adjustment rate for height per foot.

Parking Facilities

Parking requirements were estimated for each of the stations in Phase I based on ridership modeling and access mode rates to stations. The design efficiency considered for parking facilities in the maglev stations is approximately 375 sq. ft. per parking space. Components of each parking structure include foundations, structure, vehicle and pedestrian access such as stairs, ramps, elevators, and escalators, mechanical and electrical equipment, including collection of parking fees, and various finishing elements and landscaping.

Costs for parking facilities are based on drawings prepared by architects, and structural assumptions that have not been confirmed by engineering calculations. It has been assumed that the work will be carried out as a separate contract to the stations.

As there are a number of proposed designs for the parking lots for each station, the estimates were based on a per car basis. Two parking lot heights have been used to arrive at an average cost per car; six (which will also be used for the 5 storey parking lot) and eight levels in height. The actual expected cost for each lot will be the product of the per car estimate and the number of vehicles per parking lot.

Part III of the alignment includes parking facilities at the following potential stations:

- West Los Angeles

Operation and Maintenance Facilities

Although it is anticipated that the Central Maintenance Facility and Operations Control Center will be located in the Ontario Airport area, a secondary small maintenance facility is assumed near West Los Angeles. It would house vehicle maintenance equipment and personnel required for daily and unscheduled maintenance, and vehicle washing. Parking tracks for out-of-service vehicles would be located close to this facility. This facility would be housed in a freestanding building with one track for vehicle maintenance work, storage space for spare parts, and areas for personnel.

The costs were estimated based on drawings prepared by architects, and structural assumptions that have not been confirmed by engineering calculations. It has been assumed that the work will be carried out as a separate contract to the stations.

Propulsion/Power Supply/Operation Control

Propulsion/Power Supply (Double Track)

The propulsion system cost estimates include substations (building and equipment), wayside equipment, and the power supply and distribution equipment for the substations and route. The number of substations and their size is based on the determined operating schedule, train size, route layout (double/single-track), and route performance and characteristics (trip time, travel speed, grades, etc.).

The wayside equipment is the propulsion equipment along the route. These wayside elements include propulsion switch stations, transformers, power rails, and wayside cabling. The wayside cabling includes the propulsion feeder cables, power supply cabling and communication/control cabling (located in the same trench/way). The cabling connects the substations and OCS equipment to the wayside equipment and longstator motor (in the guideway).

The power supply equipment provides power to the substations at the 23 kV level and distributes power to all wayside elements of the system. The power supply equipment includes the following elements: substations, operating facilities, track, and stations. The operating facilities portion provides electrical power to the operation control center (including a non-interruptible supply).

Operation Control (Double Track)

The Operation Control System (OCS) consists of the safety and non-safety related equipment to control and monitor all maglev system equipment as well as provide communication (operation and passenger) and monitoring of the other portions of the route.

The OCS is the safety related portion of the control system and includes: operation control/safety technology, stationary data transmission, radio data transmission, and vehicle on-board and location components (guideway-mounted digital flags) and guideway switch control.

The Infrastructure Control System (ICS) is the non-safety-related portion of the control system and includes: operation communication, passenger communication/information, station support services (ticketing, etc.), station platform doors, emergency communication and surveillance equipment, and facilities monitoring.

OCS and ICS equipment is centrally located in the Operation Control Center and decentrally located in all facilities along the route (substations, wayside equipment, stations, maintenance facilities, and vehicles).

Sound Walls (Noise Protection)

Sound walls along the outside of the guideway are intended to reduce noise from passing train sets. An allowance for sound walls will be made for high-speed and sensitive portions (housing developments, etc.) of the alignment.

Safety Fencing/Landscape

Safety Fencing is assumed for the at-grade portions of the alignment, and Landscaping is assumed along the full length of the alignment.

Vehicles Total Cost

At the first phase of the system, each Maglev train consists of eight (8) cars coupled semi-permanently. The airport connector/suburban carriage body style (Transrapid 09) with wide doors spaced equally along the train, open style seating, baggage racks,

and amenities for standing and mobility handicapped passengers is planned for the route. The two types of cars (sections) are end sections and middle sections. The end sections are aerodynamically styled to be the leading (or trailing) end of the train and contain a "driver's compartment" with on-board control systems. One end section in each train will include a baggage compartment for airline luggage and other cargo in uniform aircraft-style containers. Each section includes the following major subassemblies: carriage body, interior furnishings, vehicle on-board operation control system (end sections only), diagnostics, vehicle location system (end sections only), HVAC, and magnetic suspension (undercarriage).

The vehicle fleet and number of sections/vehicles was estimated based on the round-trip time for each alternative, the 10-minute service headway, the train capacity and the peak passenger segment load for each alternative. Two spares trains were included in the total vehicle fleet size.

ROW/Roadway Improvements/Utility Relocation/Traffic Control

Right of Way

This includes costs associated with the purchase of land or easement rights, including relocation assistance, demolition costs, acquisition services, and the cost of purchase.

Areas where the guideway alignment is located outside of Caltrans, UPRR, or public right of way were included in the cost estimate. Right of way was categorized into areas that shared consistent land uses, typically within the same cities. Additionally, the following assumptions were made:

1) The proposed take area is a 50 foot wide air right, which is considered to be joint, compatible use. Accordingly, the land values were discounted 50%.

2) Land values for commercial, industrial and residential land were established and adjusted down as the project approached its eastern boundary.

3) All public and railroad right of way is valued as "across the fence", which we confirmed with the railroad and the County of Los Angeles Department of Public Works, who is responsible for all Flood Control and some road right of way within LA County.

4) Upward value adjustments were made for all segments where potential full takes were identified.

Roadway Improvements

The proposed Maglev alignment will be located along existing freeways and will cross over numerous local arterials. At several locations it is anticipated that existing roadways will have to be modified to facilitate the installation of the Maglev guideway structure. An allowance for reconstructing or realigning existing roadways and constructing retaining walls in order to conserve right-of-way will be included in the capital cost estimate prepared for this project.

Utility Relocation

Major utility relocations include overhead power lines, and underground facilities such as pipelines, water and sewer mains, and underground duct banks and vaults.

Costs for utility relocation are estimated using the land use categories listed below. More densely built-up areas would be expected to have more utility conflicts with a new transportation system. The following land uses are expected along the alignment:

- Dense Urban Areas;
- Dense Suburban Areas;
- Suburban Areas; and
- Rural Areas.

Traffic Control During Construction

Two basic principles guide the implementation of a highway work zone: public safety and minimum interference to traffic. And although there would be a tremendous effort to minimize the impacts of construction on traffic, a project of this magnitude would require comprehensive traffic control plans (TCPs) for the construction period. All traffic control devices will conform to the latest edition of CALTRANS Traffic Manual of Traffic Control Devices for Construction and Maintenance Work Zones and the Standard Specifications for Public Works Construction.

Cost for preparation and implementation of traffic control plans for this project are estimated at three percent (3%) of actual construction cost of the structures and guideways.

Contingencies, Project Implementation, and Environmental Mitigation

The project implementation costs are typically computed as a percentage of the total construction and procurement costs, excluding vehicle costs, which are applied separately. The implementation costs assumed for the IOS are the following:

Construction Implementation

- 25% Design/Construction Contingency
- 30% Program Implementation
- 3% Environmental Mitigation

Vehicle Implementation

- 10% Cost Contingency
- 5% Procurement and Management

Costs are estimated for complete alternatives and not on a segmented basis. The percentages are based on other completed programs and widely accepted industry standards. The following is a discussion on the components of the implementation costs and the industry standard percentages typically used for estimation.

It should be noted that the implementation costs and contingencies are added as a percentage of certain cost categories based on past experience for projects in the early stages of definition. Contingencies are not to be considered as potential savings. Rather, they are an allowance added to the basic estimate to account for items and conditions that cannot be assessed at the time the estimate is prepared. The contingency amounts are expected to be needed as the project matures.

Design and Construction Contingency (25%)

A design contingency is included in the estimate for each alternative to account for unforeseen items or quantity fluctuations and variances in unit costs. The design contingency reflects the degree of risk associated with the level of engineering data available and design completion achieved for the various design elements. A construction contingency is also included in the estimate to cover the cost of changes in the scope or changed conditions that occur during construction. Typically at a 35% level of engineering and environmental analysis, the combined design and construction contingency is 25 percent and is applied uniformly to all facility and systems costs excluding vehicles.

Program Implementation (30%)

Program Implementation Contingency covers eight project cost items. The following is a detailed discussion for each.

Program and Design Management (5%)

This category reflects the overall management and administration of the project. Included are the program manger's office, contract management and administration, project control including both cost and schedule, general administration, computer support, quality assurance, system safety, publications, public relations, support of the bidding process, agency liaison, community information and involvement, and legal support.

Preliminary Engineering and Environmental Review (3%)

This cost reflects preliminary engineering design to approximately 35% level. This will include geotechnical investigations, land surveying and mapping, engineering architecture, landscape architecture, traffic engineering, right-of-way engineering, preparation of preliminary plans and analyses in all necessary technical disciplines, and various other technical studies and support of the draft environmental document. The environmental review would entail all studies and analyses necessary to complete both federal and state required environmental documents.

Final Design (7%)

Final design and preparation of construction contingency prepares procurement documents for all facilities and systems. This will include additional geotechnical investigations, land surveying and mapping, engineering, architecture, landscape architecture, traffic engineering, right-of-way engineering, preparation of preliminary plans and analyses in all necessary technical disciplines, and various other technical

studies and support of the final design process. Design support during construction, including shop drawing review is also included in this item.

Construction and Procurement Management (5%)

This cost reflects all management of construction and procurement work after contracts are awarded to contractors or suppliers. This will include on-site inspection in both factory and field, quality control, contract administration and acceptance inspection.

Agency Costs (2%)

Agency costs represent the cost of maintaining the owner's organization during the entire program.

Forced Account Costs (1%)

Forced account costs represent the services of other organizations or agencies at the state, local or federal government level that may be required to support the project.

Risk Management (5%)

This contingency reflects the owner supplied insurance or any other allowances decided to be applied for the management of risk to the owner.

Testing and Pre-Revenue Operations (2%)

The costs of the pre-revenue testing, acceptance testing, safety certification and training related to start-up of the system for revenue service.

Environmental Impact Mitigation (3%)

Environmental impact mitigation can include a variety of costs such as traffic impact, noise and visual impact mitigation, wetlands replacement, landscaping, and aesthetic treatments. Based on recent experience with similar capital improvements in Southern California, these costs are assumed to be approximately 3% of the construction costs prior to adding contingencies and other add-on costs.

Guideway Cost Contingency (10%)

At this stage of planning, the guideway unit costs are defined per km or mile for typical elevated or at-grade guideway, regardless of curvature. They are based upon estimates from the current German suppliers of the Transrapid concrete guideway and reflect local material and personnel costs:

- Max Boegl for the guideway beams
- ThyssenKrupp Transrapid for the stator packs and equipment

Other than the design modifications due to the local requirements, the guideway beam designs foreseen for the maglev IOS are "standard" and not dependent on their installation location along the route. The quantities are currently defined according to

type and route length and not individual beams. The overall size and weight of the beams is also standard and therefore the construction costs per km or mile are relatively independent of changes to the beams foreseen at a given location. Therefore, unless the route length changes significantly, there will be little change in the overall guideway beam cost.

Taken together, these aspects allow a lower contingency to be used for the guideway beams than for other structures and equipment installed along the route (10% for guideway beams vs. 25% for other structures/equipment).

Vehicle Cost Contingency (10%)

This cost contingency is used to account for quantity fluctuations or design variances in vehicle orders. The industry standard for vehicle cost contingency is 10%.

Vehicle Procurement and Management (5%)

The vehicle procurement and management category reflects costs associated with ordering the vehicle fleets and are typically computed as a percentage of the vehicle costs. As with the vehicle cost contingency, the industry standard is 5%.

Maglev Phase 2 - I-10
Part 3: Union Station to West LA Alignment (16.34 miles)
Double Track (1 Station)
Capital Cost Estimate

Item	Quantity	Unit	Unit Cost	Cost	Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Conversion from feet to meters	0.3048									
Conversion from miles to kilometers	1.6093									
Conversion from cubic yards (cu-yd) to cubic meters (cu-m)	0.7646									
Conversion from square feet (sq-ft) to square meters (sq-m)	0.0929									
Length of Alignment (miles)	16.34									
						10.0%	30.0%	3.0%	43.0%	
Guideway					$ 323,959,000	$ 32,395,900	$ 97,187,700	$ 9,718,770	$ 139,302,370	$ 463,261,400
Type 1 Guideway	158,000	LF	$ 1,943	$ 306,994,000						
Type 3 Guideway	14,500	LF	$ 1,170	$ 16,965,000						
						25.0%	30.0%	3.0%	58.0%	
Structures/Foundations/Tunnels					$ 348,551,000	$ 87,137,750	$ 104,565,300	$ 10,456,530	$ 202,159,580	$ 550,710,600
Substructure for Guideway Type 1 and 3	86,250	LF	$ 3,800	$ 327,750,000						
Elevated Walkways	6,000	LF	$ 800	$ 4,800,000						
Sound Walls	3,000	LF	$ 1,000	$ 3,000,000						
Tunnel substructure	-	LF	$ 15,000	$ -						
Retaining Walls	1	LS	3,001,000	$ 3,001,000						
Ground Densification	1	each	$ 10,000,000	$ 10,000,000						
						25.0%	30.0%	3.0%	58.0%	
Stations/Maintenance Total Cost					$ 113,939,841	$ 28,484,960	$ 34,181,952	$ 3,418,195	$ 66,085,108	$ 180,024,900
Stations					$ 86,607,841					
West LA (Center Platform)	1	LS	$ 42,184,000	$ 42,184,000						
West LA Parking Structure	2317	Spaces	$ 19,173	$ 44,423,841						
Maintenance & Operations Facilities					$ 27,332,000					
Decentral Maintenance Facility (Building and Non-Maglev Equipment)	1	LS	$ 27,332,000	$ 27,332,000						
						25.0%	30.0%	3.0%	58.0%	
Communications/Signal/Power					$ 254,829,120	$ 63,707,280	$ 76,448,736	$ 7,644,874	$ 147,800,890	$ 402,630,000
Power Substations/Distribution	16.34	Mile	$ 10,400,000	$ 169,886,080						
Operations/Control/Communications	16.34	Mile	$ 5,200,000	$ 84,943,040						
						0.0%	0.0%	0.0%	0.0%	
Right of Way					$ 145,189,000	$ -	$ -	$ -	$ -	$ 145,189,000
Right of Way	1	LS	$ 145,189,000	$ 145,189,000						
						25.0%	30.0%	3.0%	58.0%	
Roadway Improvements/Utility Relocation/Traffic Control					$ 45,318,300	$ 11,329,575	$ 13,595,490	$ 1,359,549	$ 26,284,614	$ 71,602,900
Roadway Improvements										
Roadway Improvements w/Drainage	1	LS	$ 13,502,600	$ 13,502,600						
Utility Relocation	1	LS	$ 15,002,900	$ 15,002,900						
Traffic Control During Construction (2.5% of structure+guideway)	1	LS	$ 16,812,800	$ 16,812,800						
					System Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Subtotal					$ 1,231,786,261	$ 223,055,465	$ 325,979,178	$ 32,597,918	$ 581,632,561	$ 1,813,418,800
Cost per Mile (Double Track System)					$ 75,406,867	$ 13,654,896	$ 19,955,628	$ 1,995,563	$ 35,606,088	$ 111,012,954

Note: All costs are in year 2006$.

Maglev Phase 2 - UPRR Alignment
PART 3: Union Station to West Los Angeles Alignment (16.34 miles)
Double Track (1 Station)
Capital Cost Estimate

Item	Quantity	Unit	Unit Cost	Cost	Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Conversion from feet to meters	0.3048									
Conversion from miles to kilometers	1.6093									
Conversion from cubic yards (cu-yd) to cubic meters (cu-m)	0.7646									
Conversion from square feet (sq-ft) to square meters (sq-m)	0.0929									
Length of Alignment (miles)	16.34									
						10.0%	30.0%	3.0%	43.0%	
Guideway					$ 323,959,000	$ 32,395,900	$ 97,187,700	$ 9,718,770	$ 139,302,370	$ 463,261,400
Type 1 Guideway	158,000	LF	$ 1,943	$ 306,994,000						
Type 3 Guideway	14,500	LF	$ 1,170	$ 16,965,000						
						25.0%	30.0%	3.0%	58.0%	
Structures/Foundations/Tunnels					$ 348,551,000	$ 87,137,750	$ 104,565,300	$ 10,456,530	$ 202,159,580	$ 550,710,600
Substructure for Guideway Type 1 and 3	86,250	LF	$ 3,800	$ 327,750,000						
Elevated Walkways	6,000	LF	$ 800	$ 4,800,000						
Sound Walls	3,000	LF	$ 1,000	$ 3,000,000						
Tunnel substructure	-	LF	$ 15,000	$ -						
Retaining Walls	1	LS	3,001,000	$ 3,001,000						
Ground Densification	1	each	$ 10,000,000	$ 10,000,000						
						25.0%	30.0%	3.0%	58.0%	
Stations/Maintenance Total Cost					$ 113,939,841	$ 28,484,960	$ 34,181,952	$ 3,418,195	$ 66,085,108	$ 180,024,900
Stations					$ 86,607,841					
West LA (Center Platform)	1	LS	$ 42,184,000	$ 42,184,000						
West LA Parking Structure	2317	Spaces	$ 19,173	$ 44,423,841						
Maintenance & Operations Facilities					$ 27,332,000					
Decentral Maintenance Facility (Building and Non-Maglev Equipment)	1	LS	$ 27,332,000	$ 27,332,000						
						25.0%	30.0%	3.0%	58.0%	
Communications/Signal/Power					$ 254,829,120	$ 63,707,280	$ 76,448,736	$ 7,644,874	$ 147,800,890	$ 402,630,000
Power Substations/Distribution	16.34	Mile	$ 10,400,000	$ 169,886,080						
Operations/Control/Communications	16.34	Mile	$ 5,200,000	$ 84,943,040						
						0.0%	0.0%	0.0%	0.0%	
Right of Way					$ 145,189,000	$ -	$ -	$ -	$ -	$ 145,189,000
Right of Way	1	LS	$ 145,189,000	$ 145,189,000						
						25.0%	30.0%	3.0%	58.0%	
Roadway Improvements/Utility Relocation/Traffic Control					$ 45,318,300	$ 11,329,575	$ 13,595,490	$ 1,359,549	$ 26,284,614	$ 71,602,900
Roadway Improvements										
Roadway Improvements w/Drainage	1	LS	$ 13,502,600	$ 13,502,600						
Utility Relocation	1	LS	$ 15,002,900	$ 15,002,900						
Traffic Control During Construction (2.5% of structure+guideway)	1	LS	$ 16,812,800	$ 16,812,800						
					System Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Subtotal					$ 1,231,786,261	$ 223,055,465	$ 325,979,178	$ 32,597,918	$ 581,632,561	$ 1,813,418,800
Cost per Mile (Double Track System)					$ 75,406,742	$ 13,654,874	$ 19,955,595	$ 1,995,559	$ 35,606,028	$ 111,012,768

Note: All costs are in year 2006$.

Maglev Phase 2 - SR-60
Part 3: Union Station to West LA Alignment (16.34 miles)
Double Track (1 Station)
Capital Cost Estimate

Item	Quantity	Unit	Unit Cost	Cost	Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Conversion from feet to meters	0.3048									
Conversion from miles to kilometers	1.6091									
Conversion from cubic yards (cu-yd) to cubic meters (cu-m)	0.7646									
Conversion from square feet (sq-ft) to square meters (sq-m)	0.0929									
Length of Alignment (miles)	16.34									
						10.0%	30.0%	3.0%	43.0%	
Guideway					$ 323,959,000	$ 32,395,900	$ 97,187,700	$ 9,718,770	$ 139,302,370	$ 463,261,400
Type 1 Guideway	158,000	LF	$ 1,943	$ 306,994,000						
Type 3 Guideway	14,500	LF	$ 1,170	$ 16,965,000						
						25.0%	30.0%	3.0%	58.0%	
Structures/Foundations/Tunnels					$ 348,551,000	$ 87,137,750	$ 104,565,300	$ 10,456,530	$ 202,159,580	$ 550,710,600
Substructure for Guideway Type 1 and 3	86,250	LF	$ 3,800	$ 327,750,000						
Elevated Walkways	6,000	LF	$ 800	$ 4,800,000						
Sound Walls	3,000	LF	$ 1,000	$ 3,000,000						
Tunnel substructure	-	LF	$ 15,000	$ -						
Retaining Walls	1	LS	3,001,000	$ 3,001,000						
Ground Densification	1	each	$ 10,000,000	$ 10,000,000						
						25.0%	30.0%	3.0%	58.0%	
Stations/Maintenance Total Cost					$ 113,939,841	$ 28,484,960	$ 34,181,952	$ 3,418,195	$ 66,085,108	$ 180,024,900
Stations					$ 86,607,841					
West LA (Center Platform)	1	LS	$ 42,184,000	$ 42,184,000						
West LA Parking Structure	2317	Spaces	$ 19,173	$ 44,423,841						
Maintenance & Operations Facilities					$ 27,332,000					
Decentral Maintenance Facility (Building and Non-Maglev Equipment)	1	LS	$ 27,332,000	$ 27,332,000						
						25.0%	30.0%	3.0%	58.0%	
Communications/Signal/Power					$ 254,829,120	$ 63,707,280	$ 76,448,736	$ 7,644,874	$ 147,800,890	$ 402,630,000
Power Substations/Distribution	16.34	Mile	$ 10,400,000	$ 169,886,080						
Operations/Control/Communications	16.34	Mile	$ 5,200,000	$ 84,943,040						
						0.0%	0.0%	0.0%	0.0%	
Right of Way					$ 145,189,000	$ -	$ -	$ -	$ -	$ 145,189,000
Right of Way	1	LS	$ 145,189,000	$ 145,189,000						
						25.0%	30.0%	3.0%	58.0%	
Roadway Improvements/Utility Relocation/Traffic Control					$ 45,318,300	$ 11,329,575	$ 13,595,490	$ 1,359,549	$ 26,284,614	$ 71,602,900
Roadway Improvements										
Roadway Improvements w/Drainage	1	LS	$ 13,502,600	$ 13,502,600						
Utility Relocation	1	LS	$ 15,002,900	$ 15,002,900						
Traffic Control During Construction (2.5% of structure+guideway)	1	LS	$ 16,812,800	$ 16,812,800						
					System Subtotal	Estimated Design/Constr. Contingencies	Estimated Program Implementation	Environmental Impact Mitigation	Contingencies, Management, & Mitigation Costs	Estimated Item/System Total Cost
Subtotal					$ 1,231,786,261	$ 223,055,465	$ 325,979,178	$ 32,597,918	$ 581,632,561	$ 1,813,418,800
Cost per Mile (Double Track System)					$ 75,384,716	$ 13,650,885	$ 19,949,766	$ 1,994,977	$ 35,595,628	$ 110,980,343

Note: All costs are in year 2006$.